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COMPUTER CONFERENCING



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C·O·N·T·E·N·T·S

E·D·I·T·O·R·I·A·L

New Services

It is now 15 years since Murray Turoff invented computer conferencing as a renegade project in, of all places, the Office of Emergency Preparedness of the Executive Office of the President of the United States. (See *The Network Nation: Human Communication Via Computer* by Starr R. Hiltz and Murray Turoff, Addison-Wesley, 1978, for details.) It is seven years since Ward Christensen and Randy Suess invented the electronic bulletin board. Their article, "Hobbyist Computerized Bulletin Board," in the November 1978 BYTE (page 150) describes how they devised CBBS as a means of communications for members of their computer club and as a source of material for the club's newsletter.

Today it is clear that computer conferencing and electronic bulletin boards are the means by which personal computer users form a new kind of community, united by shared interests rather than geography. This month we examine computer conferencing in depth. We also extend our services to readers.

Many of you have written us about difficulties in getting program listings that go with BYTE articles. Some listings appear in the magazine, but lack of space prevents us from printing all of every listing in BYTE. The listings are available for downloading from our three electronic bulletin boards or from the BYTE Information Exchange (BIX), but some of you don't take part in telecommunications. Others are outside the U.S. and face technical or financial obstacles to participation.

We've been working hard to overcome these problems and are at last ready to announce some solutions. These include availability of program listings on disk, availability of computer conferencing and on-line listings throughout Europe, and free availability of listings on many bulletin boards outside the U.S.

BYTE Listings on Disks

Starting December 9, program listings for BYTE articles will be available in a great variety of disk formats. The listings are text files of source code and are to be used for noncommercial purposes only. We [...] Duplication Services, a subsidiary of Control Data Corporation, that will enable us to offer disks containing each month's listings for a cost to you of $5 for most 5¼-inch floppy disks and $6 for microfloppies, high-density 5¼-inch disks, and single-density 8-inch CP/M disks. These prices include postage in North America. Shipping and handling add $1 to the cost of orders from Europe and South America and $2 to the cost of orders from Asia, Africa, and Australia.

Which formats are available? Media Duplication Services has agreed to duplicate, at a cost permitting the prices above, any soft-sectored format that we can give them. We may need time to arrange the downloading of the listings to some osbscure formats if we don't have the target machine here at BYTE. (If you're concerned about availability of your format, call us at (603) 924-9281 and see if we have it. If we don't, we may arrange to pay you a small fee for downloading to your machine and sending us the resulting master disk for your machine's format.) We can't guarantee availability of every format, but we'll make an effort to provide any format requested. You will find an order form on page 60 of this issue if you wish to purchase listings on disk.

BYTECOM: Conferencing in Europe

Jacob Palme, author of two articles in this issue, is also the principal author of COM and PortaCOM, two conferencing programs that run on a variety of systems. COM antedates and influenced CoSy, the software on which BIX is based. QZ, the same Swedish company that developed and sells COM and PortaCOM, also offers time-sharing in Europe. QZ will be putting BYTE program listings up and conducting computer conferences on BYTE and BYTE-inspired topics. Readers in Europe can subscribe to BYTECOM by contacting QZ, Stockholm University Computing Center, Box 27322, S-102 54, Stockholm, Sweden, telephone: 46 8 679280. To reach BYTECOM via telecommunications network, you must first obtain a modem, establish an account with your local telephone administration, and then contact QZ and [...] giro 184070-1 for the equivalent of 200 Swedish crowns (about $25). Hourly connect-time charges at night for BYTECOM will be the equivalent of $6. Note that telecommunications charges themselves are billed directly to the end user by the local telephone administration; Europe lacks the kind of billing to vendor that is normal in the U.S. The telecommunications charges by telephone administrations vary from country to country but are in many cases approximately $10 to $15 per hour in the evening. See page 60 for further information on BYTECOM.

Listings on Bulletin Boards Outside the United States

There's nothing quite like the interactiveness of computer conferencing, but if using BYTECOM is difficult, you can also obtain BYTE program listings free of charge from electronic bulletin boards in many countries. We owe thanks to the many readers who responded to our request for bulletin boards outside the U.S. to carry BYTE program listings so that all readers have a means of obtaining them. Page 60 contains a partial listing of these bulletin boards. We're also making arrangements with more bulletin boards and will announce them in a future issue.

We hope these new services make BYTE more useful and valuable to many of you.

Query for Interest

We have looked at Cauzin Systems' interesting new Softstrip system. This system encodes data in graphics patterns printed on paper, and a special reader available from Cauzin reads the data into a computer's serial port. The Softstrip format packs a lot of information into a small space. We ran a test of a Softstrip on page 392 of our October issue, and the data proved readable. The disadvantage of the system is that you must purchase the Cauzin reader for approximately $200 in order to take advantage of the strips. As a means of distributing program listings, Softstrips would be an alternative to telecommunications and disks rather than a substitute for them. Please let us know whether you would like us to use Softstrips to present program listings in BYTE.


Maxell Corp. of America, 60 Oxford Drive, Moonachie, NJ 07074
maxell

Ultre, Melville, NY, announced a laser-printing engine that produces output at a resolution of 2400 dots per inch on photo film. Without a controller or case, the Ultre*Setter will cost OEMs about $5000 in quantity.

IBM announced the Pageprinter, a 12-page-per-minute electrophotographic LED-array printer priced at $7490. The Pageprinter can print text and graphics at a resolution up to 240 by 240 dots per inch.

Nanobytes

Former BYTE columnist **Sol Libes** has started a new magazine for hardware and software developers. The bimonthly magazine is $20 per year; for information, contact *Micro/Systems Journal*, POB 1192, Mountainside, NJ 07092. . . . **Hitachi** has developed a 2½-inch hard-case floppy disk that works with a prototype drive from **Suwa Seikosha**. The disk can hold up to 500K bytes (unformatted), recording on 200 tracks per inch; the drive requires only 2 watts during read and write and weighs half as much as a 3½-inch drive. . . . **MicroPro** announced release 2.0 of WordStar 2000; enhancements will include the ability to directly read Lotus 1-2-3 and Symphony worksheet files, multiple-column printing, on-screen justification, a document-history screen, and support for more than 200 printers. MicroPro also announced that WordStar 2000 will be available for the UNIX PC (running under AT&T's UNIX System V). . . . **Texas Instruments** is developing a 32-bit CMOS LISP processor chip under contract to the Department of Defense Advanced Research Projects Agency. Roughly 10 times more complex than a 68000, the 40-MHz processor will directly execute a superset of Common LISP with extensions like object-oriented programming and message passing. . . . **Waferscale Integration**, Fremont, CA, has developed a CMOS 32-bit microprocessor slice for use in standard-cell chips. The processor is rated at between 3 and 5 million instructions per second. . . . **Hitachi** and **Motorola** expected to sample a CMOS version of the 68000 microprocessor by the end of 1985. . . . **SoftKlone Distributing**, Tallahassee, FL, announced Mirror, a $50 telecommunications program it says is completely compatible with Microstuf's Crosstalk XVI. . . . **Oki Semiconductor** is now shipping production quantities of its 1-megabit CMOS ROMs. . . . **Thoughtware Inc.**, Coconut Grove, FL, announced the Jingle Disk, a Christmas card on a disk for $9.95. Holiday scenes are displayed while Christmas carols are played. The program is available for the IBM PC (256K bytes), Apple II, and Commodore 64 and 128. . . . **Lotus Development Corp.** unveiled Signal, a combined software/hardware product that lets users in major cities receive stock quotes via FM sideband radio signals and automatically enter the information into 1-2-3 or Symphony. The cost is $595 plus subscription fees for available exchange services. Lotus also recalled and replaced its initial shipment of Symphony version 1.1 after discovering a serious bug. . . . **Drexler Technology Corp.** was granted two patents in October related to its wallet-size optical-memory-card recording system. . . . **General Transformation Corp.**, Berkeley, CA, hopes to validate its Ada compilers for the IBM XT and AT early next year. The company says the $1000 XT version will compile 1000 lines of source code per minute and the $1200 AT version will compile 2000 lines per minute. . . . To avoid a court battle with **Apple**, **Digital Research** agreed to change its GEM programs (currently available on the IBM PC and Atari ST) so they will look less like Apple's Macintosh software. . . . **Pacific Bell** is now offering public switched-digital service to customers in the San Francisco and Los Angeles areas, allowing direct data transmission within those areas at up to 56,000 bits per second. Cost for the measured service starts at $197 per month. . . . Like **AT&T** and **Hitachi**, **Toshiba** has begun sampling its 1-megabit DRAMs. . . . **Intel** introduced a one-time-programmable 256K-bit EPROM that can be programmed in less than 4 seconds using a new Quick-Pulse programming algorithm. . . . **Gould AMI**, Santa Clara, CA, announced that two chips—its S35213 modem chip and S35212A filter chip—will perform all signal processing necessary for a Bell 212A-compatible 1200-bps modem. . . . **Microsoft** is shipping the XENIX System V operating system—a version of UNIX System V for the 80286—to OEMs. . . . **MicroRIM's** R:base 5000 database-manager program will be marketed by **Microsoft** outside North America and the Far East. . . . **Honeywell** introduced the XP and AP, two new personal computers compatible with the IBM XT and AT. . . . **Tiac Manufacturing** announced the PC-320, a $995 signal-processing board for the IBM PC, XT, or AT, using a Texas Instruments 20-MHz TMS32010 single-chip DSP (digital signal processor). . . . **Chips and Technologies**, Milpitas, CA, announced a 5-chip set that replaces 63 chips on IBM AT-compatible motherboards. The PC AT-compatible CHIPSet is priced at $72.50 in quantity. Another product—the 4-chip Enhanced Graphics CHIPSet—allows EGA-compatible boards to be built with 32 chips instead of the previously required 76.



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EPSON Geneva

First new 1/4-inch cartridge since 1971

If you *don't* have data worth preserving, then the reasons for buying Cartrex's new 1/4-inch, high performance, virtually error-free tape cartridge won't mean anything

But, if you are one of the many 1/4-inch tape cartridge users that assume 3M's cartridges just *have* to be "good enough" for today's high performance tape drives, read these simple facts to understand why that isn't true anymore.



The new Cartrex 1/4-inch tape cartridge is the first new tape cartridge design in almost a decade and a half. Tape drive manufacturers now have a new cartridge technology which allows them to advance beyond this previous artificial barrier.

PILOTS HAVE A SAYING, "There are those who have made a wheels-up landing—and those who will." You can apply this expression to those who have lost data and those who will. Unfortunately, data loss isn't always because users haven't backed-up their hard disk. Sometimes it's because their 1/4-inch tape cartridge, where they back up their hard disk, developed hard errors—those insidious errors that tend to increase over time. That's why Cartrex has developed a 1/4-inch data cartridge for today's high performance drives that virtually eliminates errors.

Why a new cartridge

When 3M announced its cartridge in 1971, it was designed for a low capacity tape drive with less than 3 megabytes—2.88 to be exact. The tape was low in density—1600 bits per inch with only 4 tracks and 300 feet of tape.

The tolerances required for the tape drives of the early 1970's were fine for then, but today's tape drives require much tighter tolerance. Today's tape cartridges must work with drives that have 9 or more tracks and bit densities as high as 12,000 bits per inch on 600 feet of tape. That means capacity increases of 2,000 percent packed into the same cartridge.

The reasons that yesterday's cartridge technology simply won't work properly in today's high capacity drives is inherent in the cartridge design.

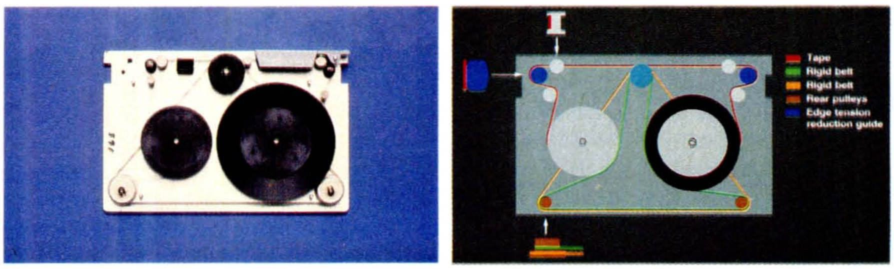
With the significant increases in capacity, the three culprits that make cartridge tolerances so important are fluctuating tape tension, redeposit nodules, and instantaneous speed variations (or ISV).

Tape Tension

Any child who has played with a magnet understands that as the magnet is separated from metal, the magnet's ability to work is decreased. So it's no surprise to find out that the closer the tape drive head is to the tape, the better the reading. This closeness is particularly important when the embedded iron filings get packed tighter in today's high density tape.

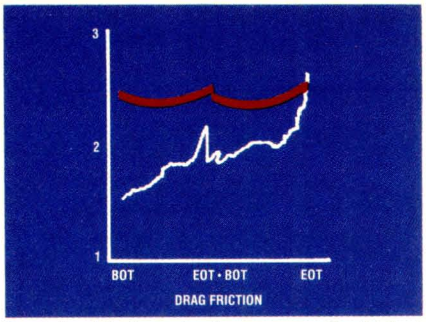
It's also important with the increase in the number of tracks. After all, you wouldn't want the head to be reading an adjacent track any more than you'd want it reading more than one magnetic representation of a bit.

Unfortunately, tape tension historically has not been constant. As the tape unwound, the tension increased. What's important is both the *amount* and *range* of tension. A fluctuating increase or decrease in tension is as unacceptable as low tension is in the first place. As the accompanying graphs



The Cartrex cartridge design (upper left) uses the N2 principle which creates head-to-tape tension by applying a mechanical differential at the rear pulley between a stiff transport belt and a stiff tensioning belt, indicated in green and yellow in the color schematic (upper right).

The conventional 3M design applies drag at the rear pulley to create tension, which creates heat, and limits future speeds much above 90 inches per second.



Good head-to-tape tension ensures the highest probability of reliably capturing data. Fluctuating tape tension allows data loss due to head-to-tape separation and smearing redeposit nodules across the tape head. The Cartrex cartridge, compared to the conventional design, creates constant and higher tension.

show, the Cartrex cartridge has higher tension and flatter profile than the 3M cartridge. This means more reliable data across the entire tape.

Redeposit Nodules

Another reason to keep constant tension is to avoid "redeposit nodules" from smearing across your tape drive's head. What are redeposit nodules? They are the insidious flakes of tape media that break off from the edges of the tape and get dragged up to the edge of the tape head. If the tension is low, or becomes low when the tape starts or reverses, the flakes come up over the edge, get smeared over the head, and reduce its ability to read the data.

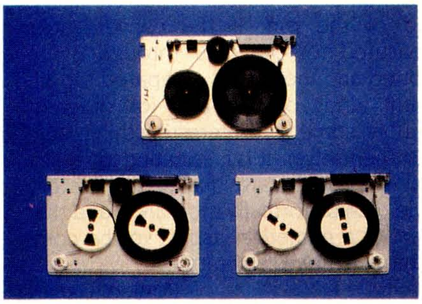
Even worse, however, is that these redeposit nodules are dragged along the surface of the tape and get embedded and packed over time. When your drive tries to read the data, the redeposit nodules act as a tent pole holding up the tape away from the head. As a result, even the best error-recognition algorithm can only tell you one thing—you've lost the data.

You might be wondering what causes the flaking in the first place. Again, it is cartridge design. The basic design uses a tape guide, shown in the accompanying illustration. The problem with this approach, is that it presupposes that the tape will always run parallel to the top and bottom caps of the tape guides. At the low speeds of 30 inches per second typical of when the 3M cartridge was designed, it was less of a problem. But at today's speeds of 90 inches per second and more, the tape wanders. When it presses against the top of the tape guide, the tape's edge pressure builds. Not only does media flake off, but you lose data due to the "coining" or "scalloping" effect.

Cartrex eliminated the cause of the tape coining or scalloping by developing a barrel-shaped roller placed prior to the tape guide. The laws of physics show that by riding on a rounded barrel, the tape will always seek the middle, reducing the tape edge pressure. This seemingly simple addition causes the tape to always enter the tape guide with zero edge pressure. In this way, the possibility of media flaking off and creating redeposit nodules is virtually eliminated.

Instantaneous Speed Variation (ISV)

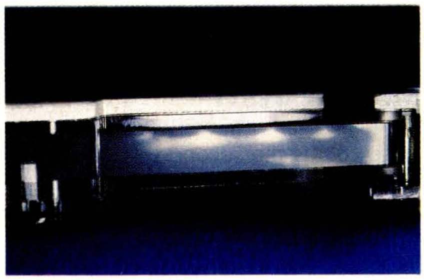
Instantaneous speed variations is exactly what it sounds like—small, instantaneous changes in tape speed as it crosses the tape head. At slow tape speeds and low bit densities—like the 1971 standard of 30 inches per second and 1,600 bits per inch—ISV wasn't as big a problem. At that time, the bits were crossing the head at 48,000 bits per second.



You can compare the Cartrex design on top with the conventional 3M design (lower left) and DEI, a 3M licensee (lower right). The omission of "edge tension reduction guides" (indicated in dark blue on the color schematic) on either the 3M or DEI design means that tape edge pressures will increase causing the magnetic media to flake off, smear across the tape head, and cause "redeposit nodules" to become embedded in the tape.

Today, however, the story has changed. 90 inches per second and 8,000 bits per inch mean that 720,000 bits cross the head every second. A 1,500% increase.

As you may have guessed, speed fluctuations in the 48,000 bits per second made reading data difficult for tape drive electronics. But when the electronics have to guess whether or not the bit rate of 720,000 bits per second is accurate, the electronics can become overwhelmed.



High speed tape without the "edge pressure reduction guide" seldom enters tape guides parallel to the top and bottom. The edge pressure which results creates "scalloping" or "coining" on the tape. The effect is data loss due to head-to-tape separation, flaking media that smears across the head, and "redeposit nodules" that create hard errors.

Never a Single Issue

Your tape drive seldom has the luxury of dealing with an isolated problem. It's usually a combination of ISV, redeposit nodules, and tension problems all together. Now you understand why Cartrex wanted to develop a cartridge for a market that needed a modern alternative.

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More Travesty

Murray Lesser's "Travesty Revisited" (July, page 163) is the second BYTE article to present a compiled-language version of Brian Hayes's random text generator (the first was "A Travesty Generator for Micros" by Hugh Kenner and Joseph O'Rourke, November 1984, page 129). If the subject is really that interesting, an interpreted BASIC generator would make it available to a larger number of casual programmers. Lesser's program is too loopy to run well in an interpeted language, but a usably fast version could be derived from his listing if lines 86 through 106 were replaced with those shown in listing 1.

My code embodies a small variation on the Hayes algorithm but is functionally equivalent to it. It requires a BASIC interpreter that allows long string variables, and LETTER(*n*) should be dimensioned to 255, which is large enough to handle input files of 10,000 characters or so as long as the scan order is greater than 2.

A generator using this stragegy and written in MS-BASIC (1.0) on a Macintosh runs a 1000-character in/out benchmark in 90 seconds. This compares well enough with the 130 seconds reported by Kenner and O'Rourke for the same test on a Heath H-89 with the original form of their Pascal generator. This is 5 to 10 times faster (depending on scan order and input-file size) than an interpreted generator using the Hayes algorithm as given.

Travesties become tiresome very quickly, but the method itself can lead to valuable insights into written language if one has the patience to follow up some of its formal results. For example, the generator allows the computation of several constants that measure aspects of the text in the input file. The easiest of these to handle is linear convergence, which is given by $(\Sigma(1/T))/C$, where T is the number of matches to each gram and C is the total number of output characters. Linear convergence measures the tendency of the source text to reproduce itself through the generator. At high scan orders (greater than the number of characters in the longest recurring string in the text) its value is 1, and for lower orders, less than 1. It can be approximated very well by adding the function T = T + 1/LETTER(0) as the second line under the WHILE statement above, and then dividing T by the total number of output characters at the end of the run. If the convergences measured for orders 3 through 8 are plotted and the curves compared for different kinds of text and for different authors, some very interesting things suggest themselves. It is fascinating to realize that so nebulous a quality as "literary style" can be formally measured, and that there is a numerical aspect to the comparative study of literature.

Robert Green
Annapolis, MD

Murray Lesser replies:
In response to Mr. Green's letter, I offer a few comments. First, the program as published does an order-4 verse scan of "Jabberwocky" (1013 bytes) with 1000 bytes output in 33 seconds on my IBM PC. Time is by stopwatch, files are on memory-mapped virtual disk.

Second, the intent was to make minimum changes to the program structure established in the original article by Kenner and O'Rourke. The purpose of the piece was to show the effect of a more suitable language, not to monkey with the algorithm.

A major performance improvement for very long input files (over 5K bytes) is to eliminate the repeated input string concatenation with every character accepted. This can be done with a couple of assembly-language subroutines to write the entire input string into string space only once, albeit one character at a time. I leave this as an exercise for the interested reader.

If the technique is to be used for anything other than a stunt, the program should be restructured in a major way. For example, if one were to implement Mr. Green's suggestion of using it to compare "literary style," the program should run all the desired outputs from a single reading of the input, gather the appropriate statistics, and then move on to the next input file.

Finally, I wouldn't use an interpreted language for anything. In addition to the performance improvement, it is much easier to write and debug long programs for a compiler than it is for an interpreter. Try it; you'll like it.

Hope and Pascal Recursion

I would like to respond to Roger Bailey's article "A Hope Tutorial" (August, page 235). In comparing Pascal with Hope on the mult function, he only showed an example of writing the function in Pascal using iteration. It is possible to write the function in Pascal using recursion (as shown in listing 2). This method is not the method normally taught to students, since recursion is not always the best route to follow. Except for that one example, I think

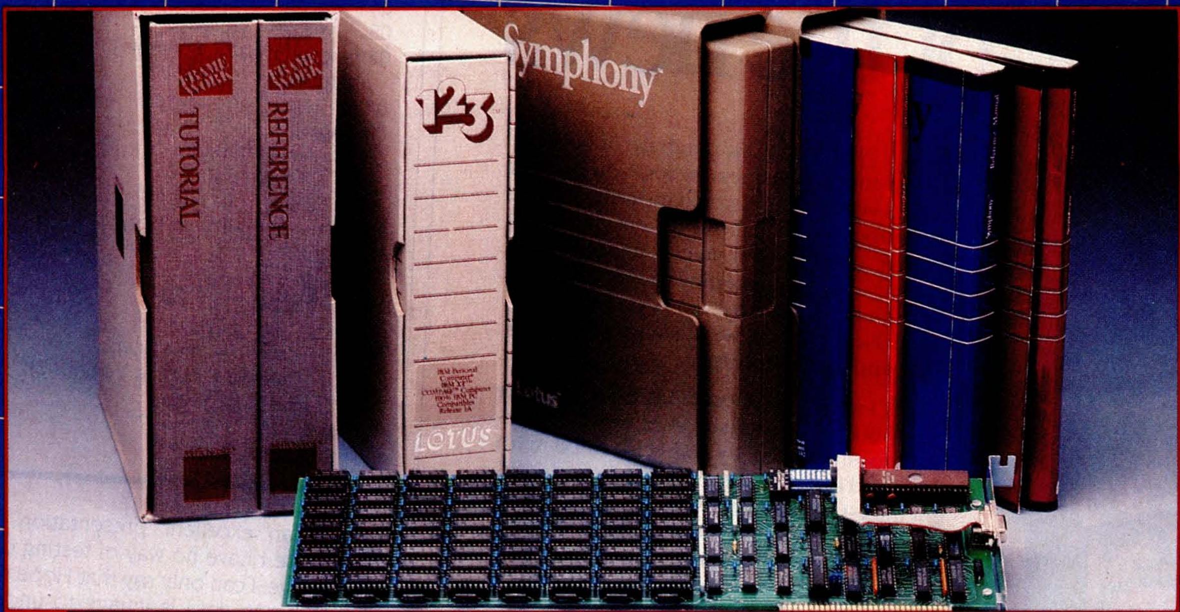
(continued)

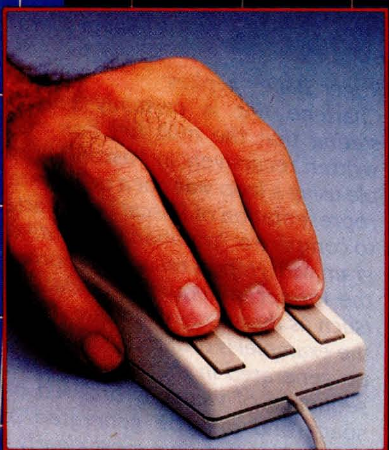
Listing 1: *Reader Green's modification to* TRAVPC1.BAS.

```
   LET I = INSTR(STRING,PATTERN)              'Scan for first match
   LET LETTER(0) = 0                          'Initialize match count
WHILE I>0 AND I< = LEN(STRING) - N.PAT        'Set loop conditions
   LET LETTER(0) = LETTER(0) + 1              'Increment match count
   LET LETTER(LETTER(0)) = I                  'Record match location
   LET I = INSTR(I + 1,STRING,PATTERN)        'Scan for next match
WEND                                          'Repeat
   LET L = INT(LETTER(0)*RND) + 1             '1 < random integer < = match count
   LET OUTCHAR = MID$(STRING,LETTER(L) + N.PAT,1) 'Record selected letter
```

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Listing 2: A *recursive* mult *function written in Pascal.*

```
01 program test (input, output);
02
03 var
04   x,y, num : Integer;
05
06 function mult (x,y :integer)
     :integer;
07
08 begin
09      if y = 0 then
10         mult := 0
11      else
12         mult := mult (x,y - 1) + x
13 end;
14 begin
15      repeat
16         read (x,y);
17         num := mult (x,y);
18         writeln (' num is ', num : 3);
19      until num = 0
20 end.
```

this was an excellent presentation of Hope. Since I have no way of testing out the language, I can only say that Hope appears to be an easy language to understand.

CHARLENE FILZ
Santa Clara, CA

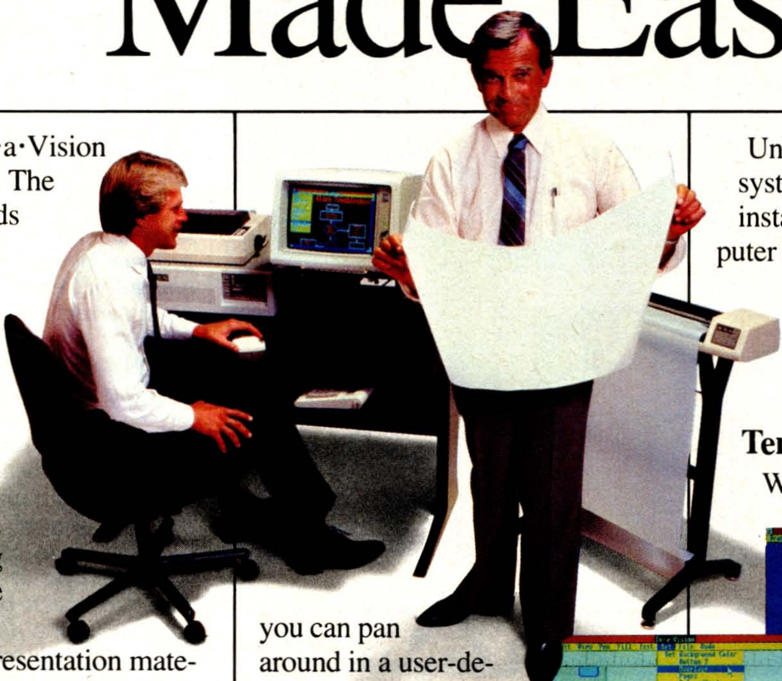
Roger Bailey replies:
Charlene Filz is certainly correct in stating that the mult *function may be written recursively in Pascal. My example using a loop was not a deliberate misrepresentation of Pascal but an attempt to compare a "traditional" iterative program with Hope's recursive approach. In the former, a sequence of data values (such as the successive values of* prod *in the example) is ordered in* time *and must be generated in that order; in Hope, a sequence of values is ordered only in space and may be generated in any order. This is shown most clearly in the Pascal and Hope versions of the programs for printing a sequence of natural numbers, and it is the property of Hope that makes it so suitable for parallel machines such as ALICE.*

As Ms. Filz correctly states, the recursive method is not normally taught to students, which is very unfortunate. Recursion is widely regarded by practicing programmers as "inefficient" or even "unnatural," yet neither of these criticisms bears up to examination. The

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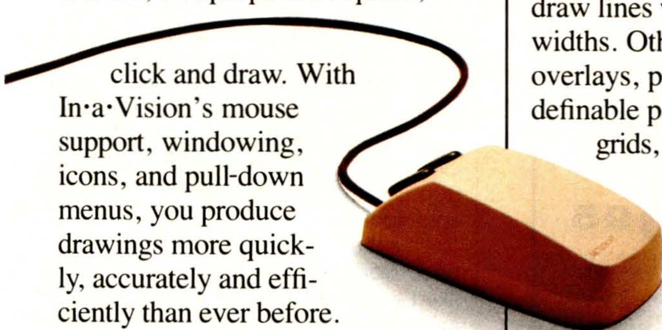
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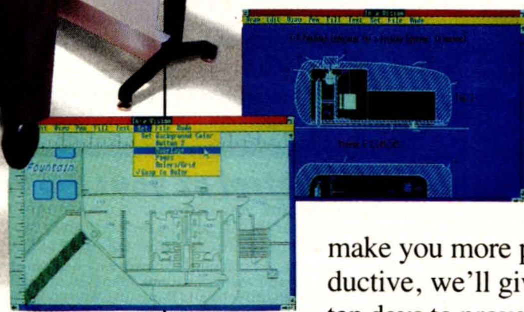
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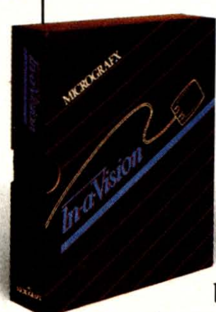
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Inquiry 242



first goal of all programming is to produce programs that are demonstrably correct. What use is the program that is highly optimized yet gives unreliable results or crashes unpredictably?

Clarity and conciseness are our greatest aids to correct programming and recursion provides both. Compare Ms. Filz's recursive mult *with my iterative version: It consists of only two statements, has no variables, and more importantly, no concept of states because no values get changed when it's evaluated. It can be seen to be correct without testing or hand-simulation, whereas the iterative program needs much more careful examination before we can be sure it will work correctly.*

Except in rare circumstances, I would always favor a recursive Pascal program over the equivalent iterative one. Recursive procedures are handled as efficiently in Pascal as nonrecursive ones. As for the charge that recursion is unnatural, I would simply remark that all programming languages are unnatural until they've been learned. In the Department of Computing at Imperial College, we teach recursion before any of Pascal's loop constructs, and our students regard it as completely natural. To those of your readers like Ms. Filz who like the style of Hope but have no way of testing it, I should mention that it's even possible to write Pascal programs that manipulate large data structures in a completely functional style.

OKAY, BLAME THE COMPUTER . . . SOMETIMES

It was interesting to read Michael Russell's letter ("Don't Blame the Computer," August, page 14). His examples of what some people called "computer mistakes"—poorly scheduled lunch periods and a $6539.97 phone bill—are indeed, as he points out, attributable to human error.

I get the impression from his letter, however, that he is unaware of the fact that true machine-based errors are very common.

Over the eleven years in which I have been working with computers, it seems like I have encountered a roughly equal number of machine-based and human-based computer errors.

A bug in software, an obvious design flaw in hardware, or an error in operations are all human-based errors, of course. Machine-based errors occur when, for example, a semiconductor component fails (for no apparent reason), when a

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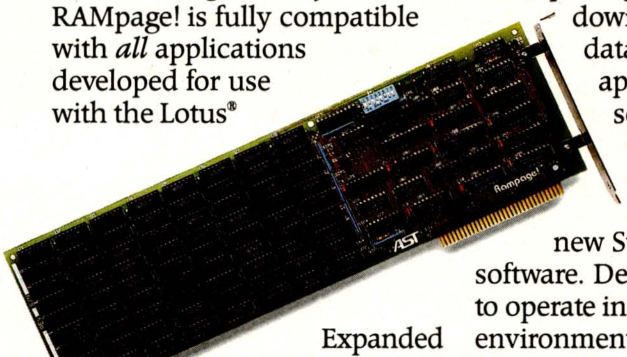
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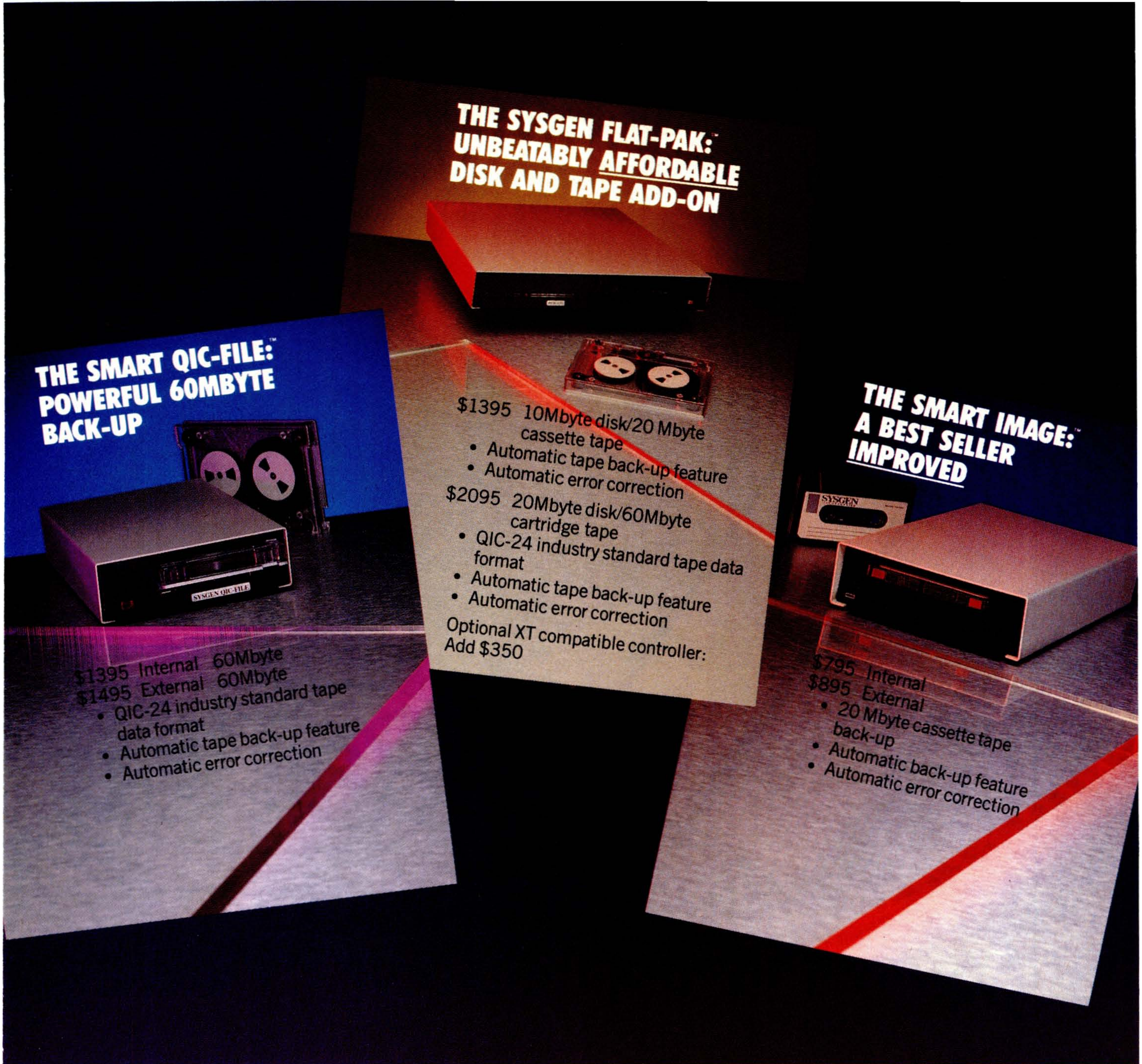
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Some people will likely object to this list on the basis that all these errors have some cause external to the computer itself. Some possibilities are: an error made during manufacture, a cosmic ray striking an integrated circuit, static electricity, or an oversight in the design.

But, to be fair, realize that human errors have their external causes as well. A programmer may be distracted by a phone call and return to his terminal with his thought pattern disturbed; he may then unknowingly introduce a bug into the program. A looming deadline may mean that prerelease testing is cut short. Many other examples (some would say "excuses") can be found.

Here I have been making the distinction between machine-based error and human error. Mr. Russell, however, simply refers to "computer errors." Since most users (understandably) view the computer as an undifferentiated entity separate from themselves, it may be more appropriate to draw the distinction between computer error and user error.

It seems to me the computer did make a mistake in printing the $6539.97 phone bill. So what if the programmer programmed the fault into the software? The fact that the computer error could have been prevented by a programmer at some point in the development of the system does not change the fact that the computer made the mistake.

Of course, a computer is only a tool. If the operator or user enters wrong data or gives faulty commands, the direct result is his mistake (user error).

If someone makes a mistake while creating a program, the result is a faulty program, or in a larger sense, a flawed computer. When that program is later executed, any wrong answers from correct

(continued)

user input can rightly be called computer errors. It is interesting to note that a program could have several bugs (in that it did not correctly meet the design objectives) and never generate any errors (where the conditions to trigger the errors never occur in practice).

Why do we wish to ascribe to computers the inability to err? If our child hits a baseball through a window we are quite ready to blame him for it, not ourselves for failing to ensure that "not hitting the window" had a sufficiently high priority in his "operating system."

In summary, my point is this: Computers are prone to errors, just as humans are. This is true regardless of whether you use the narrow definition of a machine error or the broader (and I feel fairer) concept of the computer system as a whole.

The difference, of course, is that a computer generates fewer errors for a given amount of work produced and the probability of any given error being made is much less for a computer than it is for a human.

TERRY J. DEVEAU
Bedford, Nova Scotia, Canada

AND NOW, ADWARE

In response to the letter by Mr. Tate ("Don't Sell Software, Sell Ad Space," August, page 26) regarding the selling of advertising space in entertainment software: Wow! What a great idea. *Adware* (that's my term for it) could resurrect the failing home computer industry.

Let's face it, most home computers are used for entertainment; however, the general public is not usually willing to spend $30 to $100 for a game. In general I feel that this attitude applies to all types of home entertainment. Look at how successful television has become simply because you don't have to pay for it to enjoy it (unless you want cable or pay TV, but even that is relatively inexpensive). With Adware you would still have to incur the cost of downloading from the telephone. This same reason also accounts for the to-date unsuccessful home videotex systems.

Mr. Tate mentions the advantages of Adware but fails to mention the virtues of the Freeware concept and what Adware could bring to it. I personally do not agree with the idea of selling copy-protected entertainment software commercially. Computers are very good at copying software, and so this fact should be put to good use. Freeware (the free distribution of software by encouraging copying) offers the users a *better* and more *dynamic* product. For example, I have a Freeware product that I continue to update as improvements and additions are implemented. When a new release is ready I simply make it available on the Freeware market. You cannot do this economically with a similar commercial product without covering your expenses by raising the retail price. With Adware you could make it a policy to release a new version every few months to insure a dynamic advertising medium.

At present the Freeware distribution network is not firmly established, but if the amount of Freeware and the demand for it grew large enough I am sure that regular channels would establish themselves quickly so that everyone could have almost immediate access to the updates. Another benefit of this concept would be

(continued)

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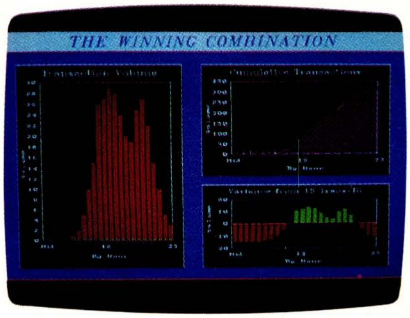
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to ensure the survival of the best games. These will get the best advertisers, ensuring their survival and offering you and me the best quality entertainment from these marvelous little machines.

So how about it? Is it time for another revolution in the home computer game market?

WESLEY STEINER
Vancouver, British Columbia, Canada

A HEATH TIMELINE

I enjoyed your list of microcomputer milestones in the tenth anniversary issue (see "A Microcomputing Timeline" by Gregg Williams and Mark Welch, September, page 198). However, I must add my voice to the probable hundreds of others who will be pointing out that one pioneer in the field was entirely ignored. Namely, the Heath Company. Following is a list of a number of events unique to the Heath contribution to microcomputing:

August 1977: The H-8 was introduced. 8080 microprocessor. Octal front-panel keypad. Bus-type architecture. The first microcomputer kit that an average person could expect to successfully build and use. Still in daily use and supported by several third-party vendors.

August 1977: Benton Harbor BASIC. High-level language and quasi-operating system for H-8. Operated with the ultrareliable Heath cassette interface (1200 bps, vanishingly small error rate).

October 1978: H-19 introduced. At the time, the H-19 was one of the lowest-cost intelligent terminals available. Used a Z80 microprocessor. All commercial CP/M software eventually included H-19 control codes in their installation protocols. Still in daily use. For a time, the H-19 led the market in terminal sales.

June 1979: The H-19 terminal was upgraded with a Z80 computer card and became the H-88. Still used the 1200-bps cassette interface. Shortly after this, disk-drive peripherals were offered for the H-8 and H-88 (which then became the H-89). Benton Harbor BASIC was upgraded to Extended Benton Harbor BASIC, which included disk file functions and for a short while was Heath's disk operating system. (Microsoft BASIC was also a language/operating system when first introduced.)

October 1980: H-DOS was introduced. Predated MS-DOS in the use of modular device drivers for peripherals. This system was proprietary and failed in competition with CP/M, though many felt it to be a superior operating system. It has its own ZCPR-like add-ons and is supposed to be available in version 3.0 "real soon now." In daily use and supported by several third-party vendors.

December 1982: The H-100 series introduced. This model was marketed earlier by Zenith Data Systems as the Z-100 series. A dual-processor machine (one of the first), it included an 8085 for handling 8-bit CP/M programs and an 8088 for MS-DOS and CP/M-86 capability. Included five S-100 slots for expansion. One of the first to conform to IEEE S-100 standards as several Heath engineers were appointed to the committee.

All of these products are (were) available

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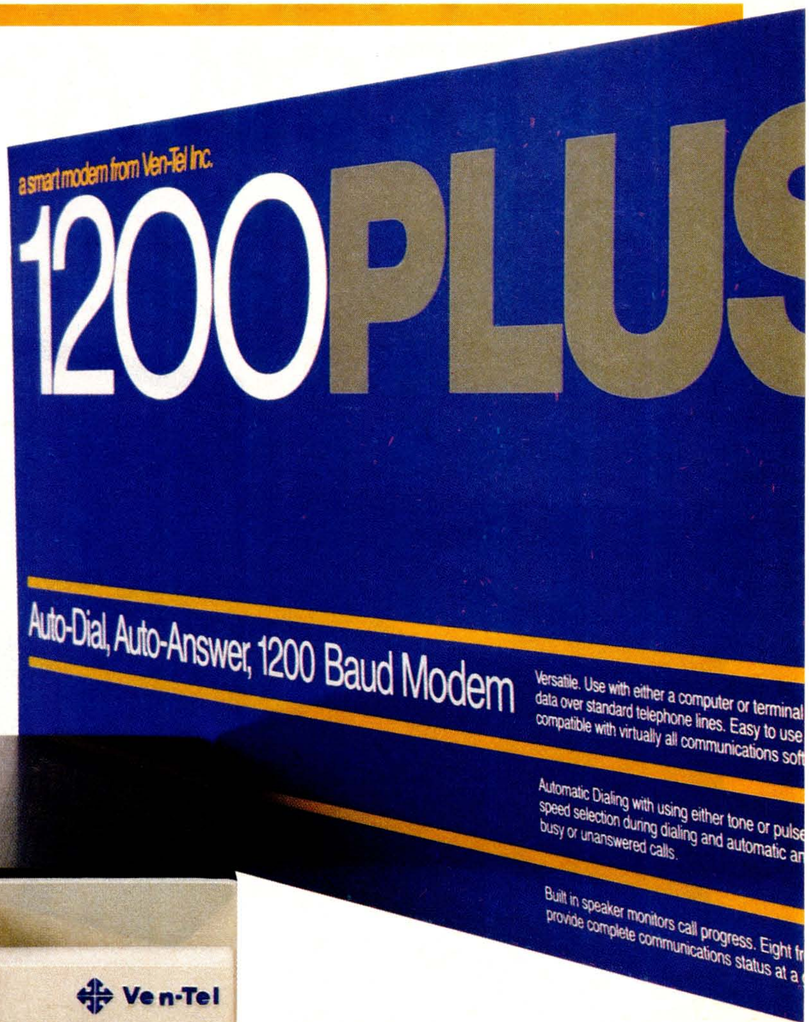
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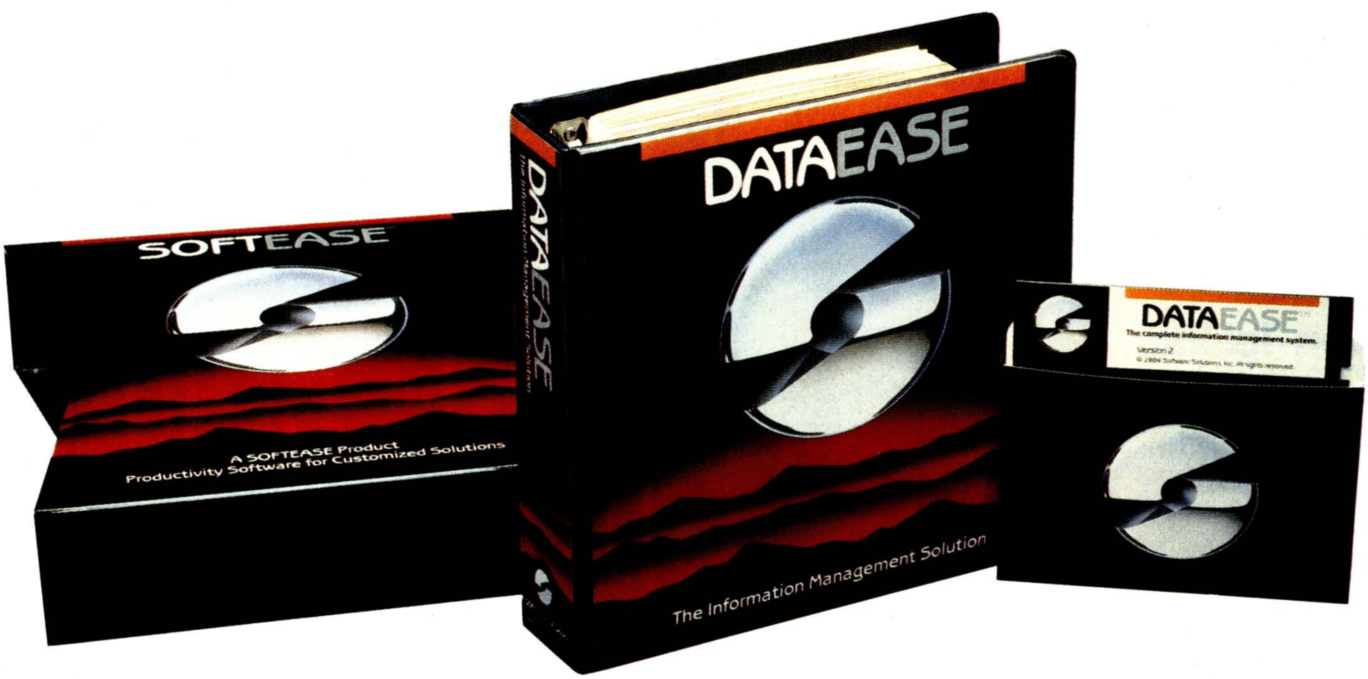
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both as kits and preassembled units. The Heath Company is now a unit of the Zenith Corporation and its assembled computer products are sold under the Zenith Data Systems name.

Heath also pioneered in the larger system arena when it introduced the H-11, which was a Digital Equipment Corporation minicomputer in kit form. It was too expensive to compete in the personal computer market; nonetheless, it was offered and supported for several years. Software was never readily available to the average person.

Heath and Zenith computer owners are supported by a large network of third-party vendors of software and peripherals. At least two commercial newsletters and one commercial magazine are dedicated to the brand. There is also the inimitable Heath Users' Group with about 25,000 members worldwide. Its monthly journal, REM*ark*, and software library are, in my opinion, unmatched. You may also find the very active HUG-SIG on CompuServe of interest. (One has to be a HUG member to log on the SIG.) Numerous local groups such as our Tallahassee Heath Users' Group (Tally-HUG) are available.

To sum up, the Heath computer user community has been a cornerstone of the personal computer movement from early on and deserved a prominent listing in a compilation of historical microcomputer events.

WELBREY A. HILL
Tallahassee, FL

DECLARATIVE FEEDBACK

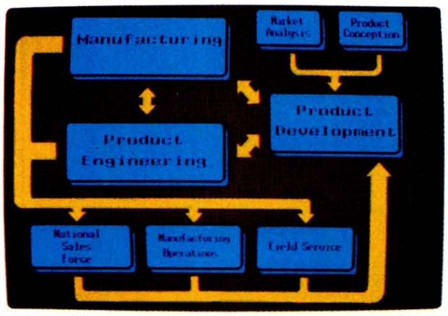
The August issue had as its theme declarative languages, hailed as the next step forward for programming. One of the most prominent of the languages featured was Hope, two articles and a column being devoted at least in part to it (see "Program Transformation" by John Darlington on page 201, "A Hope Tutorial" by Roger Bailey on page 235, and "BYTE U.K.: Declarative Update" by Dick Pountain on page 341). There is a point I wish to make about the way source code is presented to the programmer in Hope, and maybe some other languages.

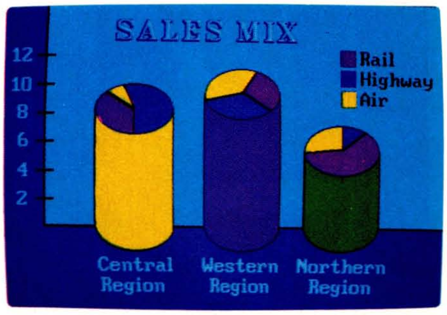
The use of symbols instead of plain English used to be a thing of the past, an evil caused by a lack of memory and processing power. Now that there is not as much of a limitation in processing power, there is no excuse for these symbols being used any more than for a modern interpreter giving error numbers instead of proper messages.

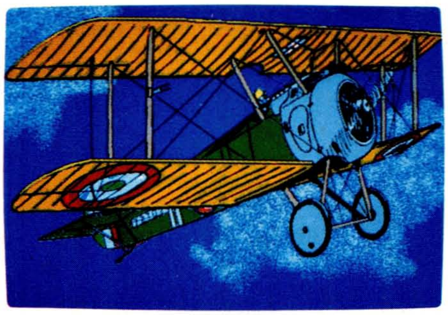
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160 Sir Francis Drake Blvd., San Anselmo, CA 94960, 415/456-0955

Inquiry 396 for End-Users. Inquiry 397 for DEALERS ONLY.

Hope appears to be offering the path back to using these symbols for their own sake. In Mr. Bailey's article we come across the phrase "should be read as" many times. In each case we are told that some symbols should be read as a certain phrase of English. Why can the interpreter not display the English, allowing us to read it directly? Surely the computer could accept the English instead of the symbols when source code is input? I will concede that it may be harder for the interpreter to parse the English, and it takes longer to input, but the interpreter could compromise and accept the symbols in input while expanding them in listings to the full English. This is similar to some BASIC interpreters that allow the PRINT statement to be input as ? and then expand it to its full form in listings. Bearing in mind the fact that the version of Hope used by Dick Pountain in his BYTE U.K. column rearranged the order of the source when it was displayed and put function declarations in a separate order from their equations when the workspace was saved, it seems apparent that the extra processing required to expand the symbols to English is minimal.

Let us hope (!) that this use of symbols does not drag us back to unfriendly and difficult-to-read source listings.

ANDREW MENADUE
Hayle, Cornwall, England

Having just finished reading the August BYTE, with particular attention to the theme section devoted to declarative programming languages, I want first to express my appreciation to the editors for the quality of the articles presented. Susan Eisenbach and Chris Sadler's "Declarative Languages: An Overview" (page 181) was of particular interest to me and serves admirably to provide perspective on the background of the subject, particularly for one who has no ax to grind for any programming language in particular.

Even the inevitable redundancies amongst the several articles in reciting the advantages of precise problem formulation, facilitation of parallel processing, and reduction of programming effort may finally help to persuade even the more conservative members of the profession. Others have noted many times the common reluctance of programmers to abandon the comfort of whatever language they learned first. Witness FORTRAN!

The notion of using atomic routines coded in machine-efficient modules and organized through problem definition by task lists in functional form is clearly not new. I have just reread a speech of my own, given in the spring of 1961 as one of a series held in connection with MIT's Centennial Year. The speech was entitled "A New Concept in Programming" and appears in the book *Management and the Computer of the Future* edited by Martin Greenberger (The MIT Press and John Wiley & Sons, 1962). Granted that the technology has advanced far beyond what most might then have anticipated, I still feel that the ideas could have been applied more generally and quite profitably, even then. Perhaps the profession may soon recognize that such notions can apply far more widely than to artificial intelligence alone.

GEORGE W. BROWN
Irvine, CA

(continued on page 424)

Inside Apple Vol. 2, No. 1

Here's the inside story on all the colorful things that have happened at Apple.

Go ahead, accuse us of sensationalism.

Over the next four pages, we're going to bare our specs and divulge all the nitty gritty details about the latest developments to come out of Apple Computer.

Starting with our new Apple® ColorMonitor IIe and Color-Monitor IIc.

In all modesty, we think these are the best color monitors you can buy at any price for your Apple II, II+, IIe or IIc personal computer.

Both have composite color, 13-inch screens that let you produce a dazzling array of multi-hued graphics. Without going to the expense of adding an RGB interface card or external adaptor.

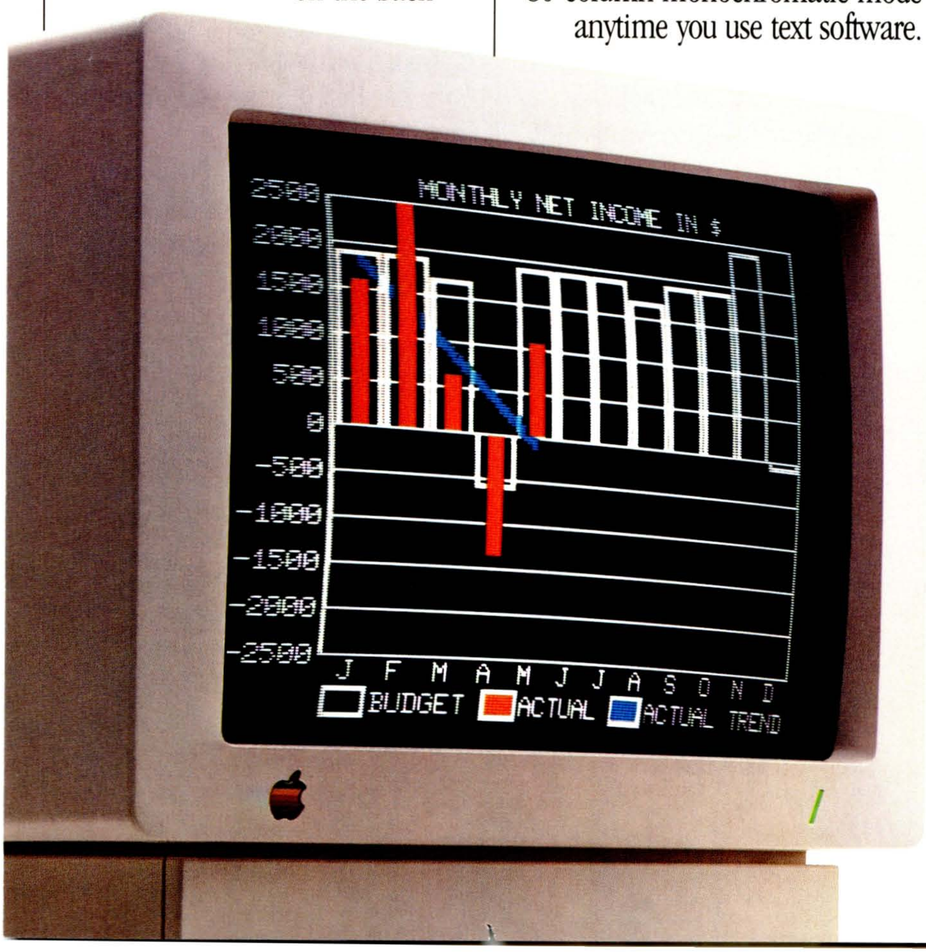
Simply plug the monitor directly into the video output jack on the back of your Apple, and you're ready to start computing in living color.

Which is terrific for games and graphics oriented programs like Apple Logo II, Instant Pascal™ and Dazzle Draw.

But not quite so terrific for text programs. As anyone who's ever gone blurry-eyed from trying to read words on a color CRT will readily attest.

Not to worry.

We've designed both Color-Monitors to automatically go from color to a high resolution, 80-column monochromatic mode anytime you use text software.



As you can see, we've also styled each ColorMonitor to fit in with our family looks. The Color-Monitor IIc is pure white, and has an optional rigid stand. While the ColorMonitor IIe is designed to rest



The ColorMonitor IIe on a IIe.



The ColorMonitor IIc on a IIc.

on top of your Apple IIe, and comes in our favorite shade of beige.

And thanks to some particularly bright Apple engineers, our ColorMonitors are compatible with virtually all existing Apple II software.

Well, there you have it. The scoop on one of the most colorful events in Apple history. But as you might expect, it's certainly not the whole story.

If you turn the page, you'll see that the saga continues.

The truth about our new color printer in black and white.

In case you haven't heard, Apple has a whole new cast of characters.

Our ImageWriter™ II printer.

Like its predecessor, the original Apple ImageWriter, our ImageWriter II is one of the most dependable dot matrix printers very little money can buy. And it's compatible with every Apple personal computer.

But that's where the similarities end.

The ImageWriter II prints faster and clearer than the original ImageWriter.

It cruises through drafts at a blazing 250 characters per second. Produces sharp graphics. Creates near letter-quality text. And lets you print in six vivid colors.



ImageWriter II 32K Memory Option.

Simply change the black ribbon to the continuous cloth, multi-color ribbon, and you're ready to churn out reams of yellow, red, blue, orange, green and purple output.

You can print pictures and greeting cards with software like Stickybear Printer. Design your own color drawings with Blazing Paddles and Dazzle Draw. And whip out color business graphics using SuperCalc 3A, pfs: GRAPH or Mouse Calc.

As you would expect, you can vary the pitch and spacing on the ImageWriter II. And print in standard or half height.

But as you would probably never expect, the ImageWriter II is also expandable.

By adding the ImageWriter II 32K Memory Option print buffer, you can continue to compute while the printer continues to print.

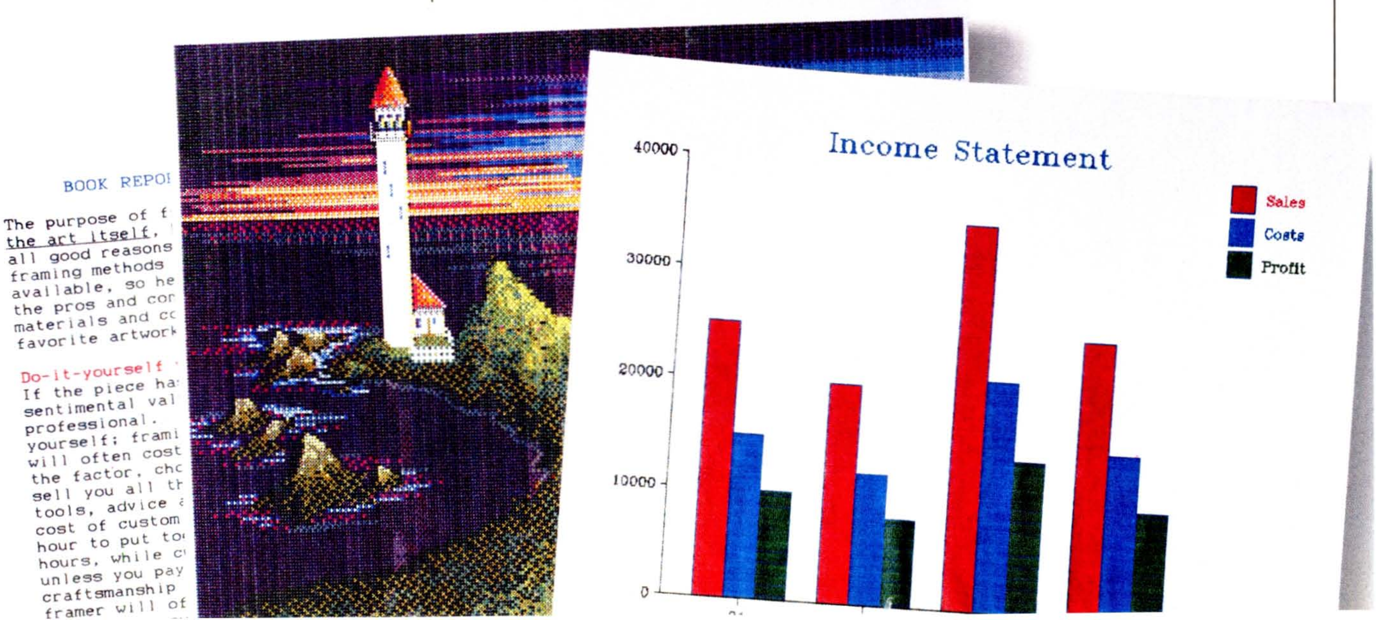
Attach the ImageWriter II SheetFeeder, and you can automatically load single sheets of paper into the printer.

And by having your authorized Apple dealer install our AppleTalk™ Option, the ImageWriter II can even be shared by several different Macintosh™ workstations.

Which means, for businesses, it can vastly improve the looks of one very important piece of paper:

Your budget sheet.



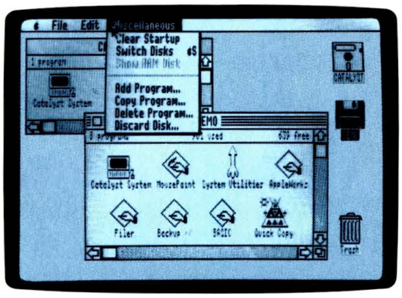


Stop flipping between floppies.

We call it the "floppy disk shuffle."

Having to boot and re-boot floppy disks every time you want to go from one application to another.

Well, the end of your shuffling is in sight.



Catalyst 3.0 with desktop icons.

Quark, Inc., will soon be shipping a unique new program called Catalyst™ 3.0 that's designed to be used with Apple II computers equipped with mass storage.

Catalyst 3.0 lets you install multiple programs on a single storage device. Macintosh-type desktop icons show you what's loaded on the program. To select the item you want, simply use an optional mouse or keyboard to open the file.

Look for Catalyst 3.0 to show up on dealer shelves soon.

Then you'll finally be able to boot all those floppies for good.

A plug for our new modem.

With the introduction of our new Apple Personal Modem, we've solved one of the biggest problems known to modems:

Where to hide them.

The Apple Personal Modem plugs directly into a standard A/C wall outlet. So unless your computer room is decorated with paisley wallpaper, it'll blend right into the immediate surroundings.

Of course, aesthetics aside, it's also one darn good modem.

The Apple Personal Modem offers 300/1200 baud operation. Has the latest VLSI technology. Features automatic dial, re-dial and answer capabilities. Uses the industry standard Hayes AT Command Set. Plus it's totally compatible with current Apple communications software.

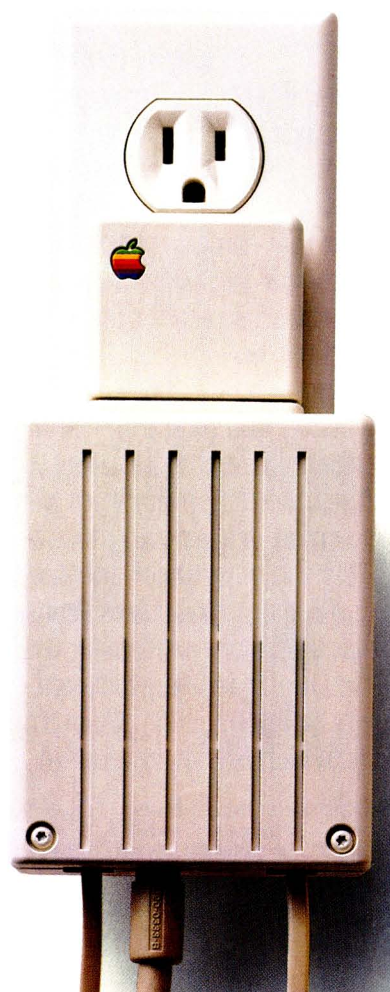
And even though we designed the Apple Personal Modem to be out of sight, there's one part of it that's definitely not:

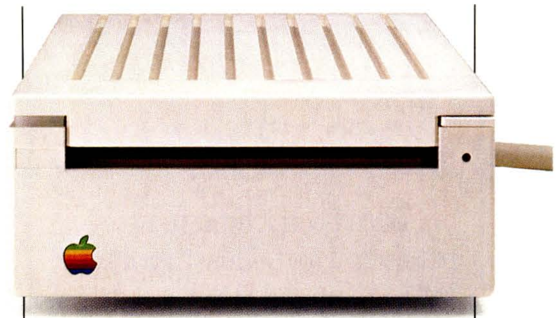
The price.

We've increased our drive.

Our capacity for work just got bigger.

The new Apple UniDisk™ 3.5 external drive uses 3½″ dual-sided microdisks to add a humongous





800 kilobyte capacity to your Apple II, II+, IIe or IIc. Which is more than five times the amount of storage available from a standard 5¼″ drive.

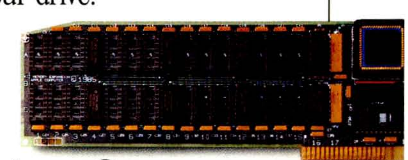
The UniDisk 3.5 is also faster than 5¼″ drives. So you'll spend less time listening to that all-too-familiar whirring sound.

You can even "daisy chain" a second UniDisk 3.5 off the first one. In case you're planning to write the next great American epic or something.

As you may not know, disk drives are the most vulnerable components of any computer system. So it's nice to know that no other disk drive is closer to fail-safe than our UniDisk 3.5.

Because no other company has our dedication to quality. Our concern for reliability.

Or our drive.



Coming Soon: The biggest Apple IIe in memory.

The Apple II Memory Expansion Card should be on dealer shelves soon.

Before long, you'll be able to instantly and easily add another 256K, 512K, 768K or full megabyte of RAM to your Apple II, II+ or IIe. Making it one of the most powerful personal computers in its class. Or business. Or home.

Snow white and dwarf monthly payments.

Once upon a time, most people had to dwindle their checking accounts down to the right side of the decimal point in order to buy an Apple.

Or stretch their charge cards to the place where they didn't have a choice but to leave home without them.

Then, mercifully, our finance department invented the Apple Credit Card.



With an Apple Credit Card, you may qualify for up to $2,500 of instant credit to spend on the Apple computer or peripherals of your choice.

And, from now until December 31st, 1985, we'll generously waive the 10% down payment.

Which means the only thing you'll have to come up with are the small monthly payments.

Getting your Apple Credit Card is almost as easy as breathing. All you need is another major credit card. And a valid I.D.*

Which means, that very same day, you'll be able to take your new Apple home.

Where you'll both live happily ever after.

Group therapy for Apple users.

Have you ever felt like you needed help—serious help—with your Apple, but didn't know where to turn?

Then we suggest you join an Apple Users Group.

From Kennebunkport to Kaanapali, Apple Users Groups are springing up by the dozen.

They meet to discuss ProDOS,™ Pascal and WPL. Exchange public domain software. Demonstrate new products. Listen to guest speakers.

And provide the kind of moral support that comes in handy after "Range error" has popped up on your DOS 3.3 screen for the 42nd consecutive time.

Many groups publish regular newsletters and magazines. And operate bulletin boards that let you get the information you want from the comfort of your own modem.

But the most important thing to know about Apple Users Groups, is that they're not just for hackers. In fact, most members have only novice or intermediate computing skills. Which is why they join in the first place.

To get in touch with the Apple Users Group in your area, check with your local authorized Apple dealer.

With over 400 Apple Users Groups already in existence throughout the U.S. and Canada, chances are the help you need is right around the corner.

Your computer should join a health club.

Computers—even Apples—can sometimes be temperamental little devils.

And if something goes wrong with yours after the 90-day limited warranty expires, you're the one who'll be out of shape.

Unless you get Apple*Care*.℠

Apple*Care* is our extended service contract that covers the cost of parts and labor for up to three years. And the annual fee is usually about half the cost of a single repair.



You can buy Apple*Care* from your participating authorized Apple dealer. And the contract will be honored at more than 2,400 Apple dealers across the country.

So even if you decide to move to some out-of-the-way place like Keokuk, your Apple*Care* coverage will go along with you.

Although we can't guarantee your family will.

** By major, we mean MasterCard, VISA, American Express, Diner's Club and Carte Blanche. Certain restrictions may apply.*
For an authorized Apple dealer near you, call ***(800) 538-9696.*** *In Canada, call* ***(800) 268-7796*** *or* ***(800) 268-7637.***

F·I·X·E·S A·N·D U·P·D·A·T·E·S

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STATEMENT OF OWNERSHIP, MANAGEMENT
AND CIRCULATION
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A. Total No. Copies Printed	487,500	476,000
B. Paid Circulation		
1. Sales through dealers and carriers, street vendors and counter sales	95,389	159,698
2. Mail subscriptions	316,859	306,236
C. Total Paid Circulation	412,248	465,934
D. Free Distribution by Mail, Carrier or Other Means; Samples, Complimentary, and Other Free Copies	5,735	4,959
E. Total Distribution	417,983	470,893
F. Copies Not Distributed		
1. Office use, left over, unaccounted, spoiled after printing	6,529	5,107
2. Return from news agents	62,988	none to date
G. Total	487,500	476,000

11. I certify that the statements made by me above are correct and complete.

—Harry L. Brown, Publisher

UPDATE

NEC Patches Compatibility Gap

NEC Information Systems now offers an alternative to Herbert Stein's patch described in his "IBM Compatibility for the NEC APC III" (see the September BYTE, page 171). The SLE adapter board, priced at $150, and the accompanying software provide almost total compatibility without affecting the operation of standard APC software, NEC said. For more information, contact NEC Information Systems at 1414 Massachusetts Ave., Boxborough, MA 01719.

BYTE'S BUGS

Mr. Slaughter Is Not Depressed

Don Slaughter of Seattle wrote to advise us of an improvement to the Macintosh, the Mini-Finder (see October, page 392). Our published version of the letter said he was "depressed" by the upgrade.

The truth is, Mr. Slaughter was not *de*pressed but *im*pressed. We apologize to Mr. Slaughter, and we hope our error did not leave him depressed. We are certain it didn't leave him impressed.

Quicksort Corrected

There is an error in the Quicksort algorithm as it appears on page 108 of the September BYTE (see "An Analysis of Sorts" by Jonathan Amsterdam, page 105). If the first element is chosen as the pivot, as the text suggests, the algorithm will not work. The solution is to swap the pivot with the last element of the array before partitioning. The corrected algorithm is shown in listing 1.

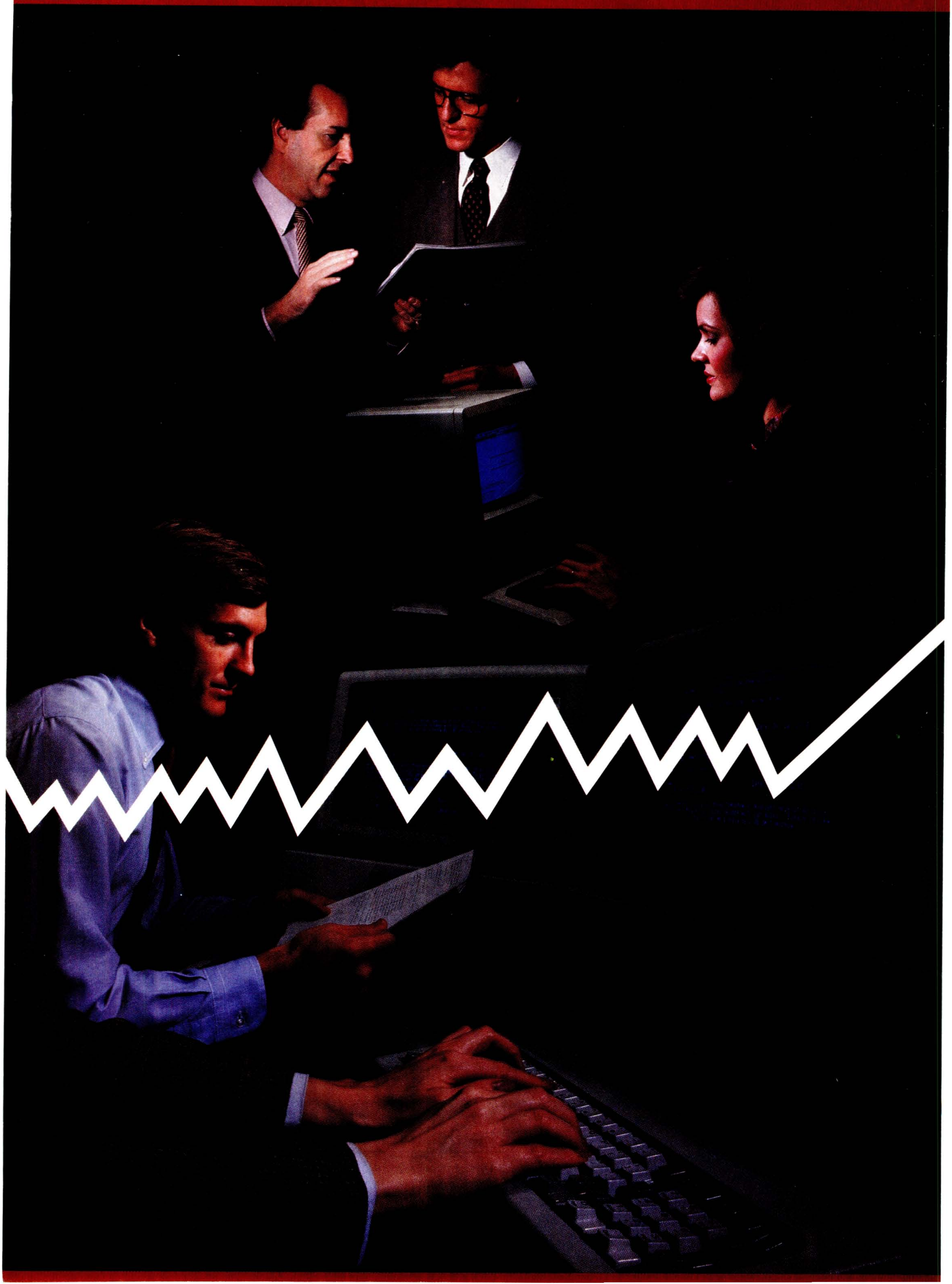
Listing 1: *The corrected Quicksort algorithm.*

```
Quicksort.
Input: an array A, with items from 1 to n.
Output: the same array, sorted.
begin
    choose a pivot;
    swap the pivot with the last element in
      the array;
    partition in the list so that all
        items < - pivot are < = i;
    Quicksort A from 1 to i-1;
    Quicksort A from i to n;
end.
```

BYTE'S BITS

Public-Domain Powerhouses, Please

BYTE is planning a theme issue on public-domain powerhouses. If you have, or are working on, a worthy application or utility that you are willing to place in the public domain, please contact Jon Edwards at BYTE, POB 372, Hancock, NH 03449, (603) 924-9281. He needs to hear from you before the end of January.




MORE USERS FOR YOUR PC
Advanced Digital's PC-Slave is the solution to your multi-user or local area network problems.
Just plug Advanced Digital's PC-Slave board into your PC expansion slot, a connecting cable, a low-cost dumb terminal or a PC look-alike terminal and you're in business. As many as 31 low-cost workstations may be added to your IBM-PC, AT, XT, and the compatibles. Share a common data base without loss of speed or efficiency since each PC-Slave has its own 8088 CPU, 256-768K RAM dedicated to each user. Advanced Digital provides additional software which supports File & Record locking and print spooling. Advanced Digital's slave concept provides the best multi-user PC system available today! For the location of the dealer nearest you contact:
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SPECIAL REPORT

Turbo Lightning Provides Fast Access

By itself, Turbo Lightning from Borland International is a flexible spelling checker/thesaurus program for the IBM Personal Computer and compatibles. However, as the first element of the Turbo Lightning Library, the program represents a gateway to a wide range of future applications. Its word-oriented search mechanisms could be used as the nucleus for a variety of sophisticated data-retrieval systems.

BASIC OPERATION

The initial release of Turbo Lightning is a memory-resident program that checks and corrects spelling as you type. It monitors your keystrokes and compares each word to those in a RAM-based dictionary. (When you install the program, you can choose one of several word lists, ranging from approximately 10,000 to 130,000 words. The size of the dictionary determines the amount of memory the program occupies. In the minimum configuration, Turbo Lightning consumes 78K bytes; the maximum is 236K bytes.) If the program can't find a match for what you have entered, it beeps. You can continue writing, or you can request a listing of alternate spellings. Using a sound-alike algorithm, Turbo Lightning builds a list of possibilities, which it presents in a window. You can scroll through the list and select a replacement.

Executing the commands of the application program you're using, Turbo Lightning moves back to the beginning of the incorrect word, deletes the word, and makes the substitution. Even if you have chosen one of the smaller word lists, Turbo Lightning lets you go to the disk and search the largest dictionary. A "full-screen check" command highlights all unknown words on the screen; as Turbo Lightning can correct only words stored in an 80-character keyboard buffer, the check is a simple way to remind yourself of uncorrected words.

You can also ask to consult the thesaurus. Starting with either your original word or any of the alternate spellings, Turbo Lightning can derive a list of words with similar meanings. The replacement routine is the same as the one already described.

Turbo Lightning comes with 11 preset "environments" that allow you to use it while working with any of five popular word processors (WordStar, pfs:Write, MultiMate, Word, and Displaywriter), Lotus 1-2-3, BASICA, Turbo Pascal, SideKick, DOS, and modem communications (straight ASCII). You can customize and rename any of the environments to match your primary software.

The program is operated with pop-up menus (similar to those used by Borland's SuperKey utility) and with single-keystroke "hot" keys.

THE DICTIONARY

A Turbo Lightning dictionary is compressed using several techniques. First, a character-frequency analysis identifies frequent letter combinations in the entire word list. The combinations are reduced to bit patterns. Next, allowable suffixes and groups of suffixes are assigned bit codes. Finally, because the words in the dictionary are stored in alphabetical order, a word can be abbreviated to a record of the changes from the previous word.

Searches through the dictionary are speeded by indexing. The program uses the first letter of a word to isolate a region of the word list, then it uses the second letter, and so on. Only a few full words are actually scanned during a search. Indices can be nested, so disk-based dictionaries can be much larger than resident ones with little loss of speed.

THE IMPLICATIONS

By combining data compression with multilayered indexing, the Turbo Lightning system can be used to provide quick access to any data organized in dictionary-like fashion. In the same way that the word list can be used as a key to the thesaurus, it could be used as the key to an encyclopedia or database. Going one step further, if the initial dictionary were replaced with a list of proper names, for example, a link could be made to addresses or phone numbers or employment records. The full-screen-check feature would provide cross-referencing capability.

Because the Turbo Lightning program generates a unique "word number" for every word in the dictionary, it could be used to develop on-the-fly data compression for communications. The sound-alike techniques coupled with the thesaurus could serve as the basis for an AI-like approximate query language.

THE FUTURE

The Turbo Lightning Library will be a collection of interrelated products capitalizing on this potential. Borland plans to release a package of word games based on Turbo Lightning, including source code in Turbo Pascal, early in 1986. The source code will illustrate techniques for interfacing external programs to the Turbo Lightning engine. Also in the first quarter of 1986, Borland will begin publishing reference works that utilize the engine for access. By the third quarter, Borland hopes to market compression/indexing utilities that allow you to convert your own data into Turbo Lightning format. The company is also open to licensing the technology to other software firms.

Turbo Lightning comes with an installation program, several Random House dictionaries, and the Random House Pocket Thesaurus. It costs $99.95. Prices for future products have not been determined. Contact Borland International Inc., 4585 Scotts Valley Dr., Scotts Valley, CA 95066, (408) 438-8400.
Inquiry 600.

by Ezra Shapiro

(continued)

AT&T's 80286-based System Merges UNIX with MS-DOS

AT&T Information Systems has released a version of the PC 6300, its IBM PC-compatible desktop computer. The new system, called the PC 6300 Plus, features a 6-MHz 80286 processor with no wait states; it's said to run approximately 25 percent faster than the IBM PC AT. AT&T said its new machine runs all software for the IBM PC or AT, including Microsoft's Flight Simulator.

The distinguishing feature of the PC 6300 Plus, however, will be its implementation of the UNIX operating system. In the first quarter of 1986, AT&T will release a full version of UNIX System V for the machine. This implementation is said to include advanced versions of many of the same easy-to-use features of AT&T's UNIX PC. In addition, because of a hardware unit called OS Merge, this edition of UNIX can run all MS-DOS applications as one of several concurrent UNIX tasks. AT&T claims that OS Merge allows MS-DOS software to "think" it has complete control over the system, thereby allowing almost complete compatibility with IBM PC software. This software, including Flight Simulator, can run under UNIX with a performance penalty of only about 15 percent.

Under single UNIX tasks, the PC 6300 Plus is said to be about 20 percent slower than the UNIX PC, which uses a 68010 processor. Under multitasking situations, the difference is even greater.

The combination of the new rendition of UNIX with OS Merge allows some interesting capabilities: You



AT&T's PC 6300 *Plus.*

can call both UNIX and MS-DOS applications from the same menu. UNIX and MS-DOS files reside on the same area of a disk, and they can be accessed by application programs under either operating system. Data can be piped from a UNIX program to an MS-DOS program and vice versa. And MS-DOS files can take advantage of the robust set of file attributes and protection facilities available to UNIX files.

The PC 6300 Plus comes with 512K bytes of memory, with sockets for an additional 512K bytes on the motherboard. Expansion boards with 2 megabytes of memory reportedly will be available soon and will allow a maximum internal memory of 7 megabytes.

The machine has one serial and one parallel port and seven expansion slots compatible with the IBM PC. Three of these slots are compatible with the PC 6300. The new system also has a socket for an 80287 numeric coprocessor. UNIX utilities will be available to take advantage of the 80287 chip.

AT&T is selling a new keyboard as an option for both the PC 6300 Plus and the older PC 6300. The keyboard has a Selectric-style key layout; it's similar to that of the IBM PC AT except that the function keys are laid out horizontally above the other keys. The older PC 6300 keyboard, which resembles the IBM PC keyboard, is also available.

The PC 6300 Plus comes in two configurations: The hard-disk model features a 20-megabyte hard disk, a 1.2-megabyte or a 360K-byte floppy-disk drive, either keyboard, and a monochrome monitor with high-resolution graphics and text capability. This version will sell for $6320. A floppy-disk-based system, which includes all the above except the hard disk and features both types of floppy-disk drives, will sell for $5095. Either system is available with a color monitor for an additional $650. MS-DOS version 3.1 with BASIC sells for an additional $65. When available, the UNIX operating system will sell for approximately $395. An upgrade is available to owners of the PC 6300 for $2995. Contact AT&T Information Systems at (800) 247-1212. Inquiry **601.**

—*Rich Malloy*

MC68000 Plug-in Board with Full UNIX System V

Motorola is now selling a 68000-based plug-in CPU board for the IBM Personal Computer. The PC/68000 hardware consists of a 10-MHz 68000, an MMU (memory management unit), a cache, and 2 megabytes of dual-ported RAM. The accompanying software contains a complete System V/68 operating system as well as an I/O kernel and diagnostics. (The System V/68 was derived from and is functionally

(continued)

NEW FROM BORLAND

Borland Introduces Reflex, The Greatest Analytical Tool Since The Couch

INTRODUCING REFLEX, THE ANALYST.

If you use Lotus 1-2-3™, dBASE® or PFS File™, you need Reflex™—because it's a totally new way to look at your data. It shows you patterns, relationships and interrelationships you didn't know were there, because they were hidden in data and numbers.

Reflex is the first database that separates the trees from the forest. The first database that understands that what you see depends on how you look at it.

The first database that probes relationships—then shows them to you in various graphic forms—scatter, line, bar, stacked bar and pie charts.

The first database to break the bonds of traditional DBMS (Data Base Management Systems) and give a dramatic visual turn to data analysis.

Reflex makes graphic leaps far beyond 1-2-3. With Reflex, when you look, you see.

HOW THE CRITICS REACT TO REFLEX

"The next generation of software has officially arrived."

Peter Norton, PC Week

"Reflex is one of the most powerful database programs on the market; its multiple views; interactive windows and graphics, great report writer, pull-down menus and cross tabulation make this one of the best programs we have seen in a long time...The program is easy to use and not intimidating to the novice...Reflex not only handles the usual database functions such as sorting and searching, but also "what-if" and statistical analysis...it can create interactive graphics with the graphics module. The separate report module is one of the best we've ever seen."

Marc Stern, InfoWorld

"What you see, then, is an interesting hybrid of a database and a spreadsheet that is ideal for analyzing tabular data."

Adam B. Green, InfoWorld

"More flexible than spreadsheets, this easy-to-use database analysis package presents information with visual clarity...Reflex is for you. The flexibility of switching between different views of the data lets you see relationships you may have previously overlooked...Without "what-if" analysis, key variables—such as cost of goods sold or travel expenses—may be out of hand but unnoticed. The type of analysis to uncover such a foible is awkward to do on a spreadsheet; yet, it may mean the difference between success and failure in a competitive situation."

Ira H. Krakow, Business Computer Systems

REFLEX OPENS MULTIPLE WINDOWS WITH NEW VIEWS AND GRAPHIC INSIGHTS.

You use Reflex's Form View to build your database; the List View lets you put data in tabular List form; the Graph View gives you instant interactive graphic representations; the CrossTab View gives you amazing "cross-referenced" pictures of the links and relationships hidden in your data. Report View allows you to import and export data to and from Reflex, 1-2-3, dBASE, PFS File and other applications and prints out information in the formats you want. In fact, Report View is probably the best 1-2-3 report generator you can buy today. It's also the cheapest—and you're getting all the other features free.

The commands for all five Views are consistent—so you're not stuck learning five different ways to get something done. And because Reflex uses advanced windowing techniques, you can see several views on the screen at the same time—without having to switch back and forth. You get the picture—and the pictures—all at once—if that's the way you want to look at things.

Modify a number and all your Views—List, Form and Graph—are immediately updated, on-screen. Changing a number changes the picture—which is mighty handy when you're analyzing (let's say) sales figures by salesperson; or you're in "What-If?" country asking yourself "What if we could add 2.5% in January sales?" "Show me."

"Give me the picture." "Show me what happens when we shift 11% of Nebraska's inventory to the new store in Hawaii." "Show me how many Gizmo 28's we have in every store in every state as of midnight last night and what happens to our East Coast stocks if the shipping strike lasts more than a week." "Show me."

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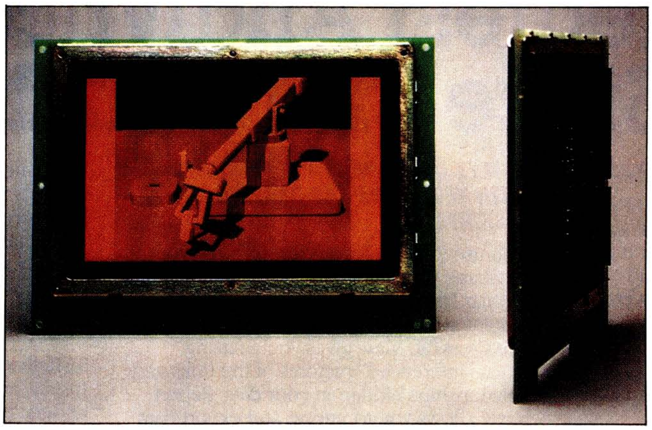
Inquiry 39 for End-Users.
Inquiry 40 for DEALERS ONLY.

equivalent to AT&T's UNIX System V, M68000 version.)

While System V/68 runs on the PC/68000, PC-DOS running on the 8088 (or 80286 in the AT) handles the 68000's I/O requests. Pressing the Alt-M key combination switches between System V/68 and PC-DOS. Motorola uses buffering and cache memory in both the main PC and on the PC/68000 card to let the 68000 run at top speed. Files may be transferred either way between the two systems.

At the same time that the new PC/68000 promises to transform IBM PC hosts into 68000 development systems, Motorola is terminating some of its older 8-bit and 16-bit development support systems. After December 31 of this year, Motorola will not accept orders for the EXORmacs 16-bit development host and peripherals; EXORciser 8-bit development host, peripherals, and plug-in expansion boards; EXORset 8-bit development host and peripherals; VMC 68/2 microcomputer system and peripherals; several other hardware development stations, bus state analyzer personality modules, evaluation modules, system analyzers, and all associated software for those products.

The PC/68000 can be used with IBM PCs that have at least a 10-megabyte hard disk. The complete PC/68000 module (hardware and software) carries part number MPCKN2M and a list price of $4500. Contact Motorola Semiconductor Products Inc., POB 20912, Phoenix, AZ 85036, (800) 521-6274.
Inquiry 602.



Planar Systems' EL8358 M *flat-panel display.*

Flat-Panel Display for MS-DOS

Planar Systems' EL8358 M is a flat-panel monitor with an electroluminescent display for MS-DOS machines. It has a resolution of 640 by 200 pixels, providing 83 lines per inch within a 5- by 8-inch active matrix. Each pixel is individually addressable and has a pixel aspect ratio of 2:1.

A complete EL8358 M, including the electroluminescent panel, driver and control electronics, bezel, frame, and connector, is 5.7 inches high, 10.3 wide, and 0.55 deep and weighs 16 ounces. It is not affected by electromagnetic environments and will run in temperatures of 0 to 55° Celsius, Planar said. It can withstand shocks of 100 Gs on all axes and storage temperatures of −40 to 75° Celsius.

The system uses patterned indium tin oxide and aluminum electrodes around a layer of bright yellow emitting phosphor. It requires a 12-volt power supply to operate.

An EL8358 M developer's kit, including a monitor, a circular polarizer, and a power supply, costs $1750. Contact Planar Systems Inc., 1400 Northwest Compton Dr., Beaverton, OR 97006, (503) 690-1100.
Inquiry 603.

Keyboard System for Visually Handicapped

The Audiodata/IBM PC Keyboard from Frank Audiodata GmbH of West Germany uses tone and speech capabilities to make the IBM PC accessible to blind and visually impaired users. The system generates different tones depending on the type of data at the cursor's screen location. To position the cursor, you use sliding switches that correspond to the horizontal and vertical axes.

The vertical switch is on the left-hand side of the Audiodata keyboard, next to the function keys. Moving it from top to bottom yields a series of tones that tells you whether lines are blank or full of text. The horizontal switch is below the space bar. Moving it left and right yields tones that indicate letters, spaces, numbers, and punctuation marks in a line. By moving the switches and listening to the resulting tones, you can tell how many characters of what type are at what position on the screen.

The keyboard contains a Votrax SC-01 speech processor, so you can literally have the system read a portion of text out loud. Pressing a button on the vertical switch tells the system to read the line of text that corresponds to its position. Using the vertical and the horizontal switches together, you can have the system read or spell particular words.

The Audiodata keyboard works with standard or large-print monitors or with no monitor at all. It comes with a 6-inch add-in card and the system software for $3450. Contact Maryland Computer Services, 2010 Rock Spring Rd., Forest Hill, MD 21050, (301) 879-3366.
Inquiry 604.

C Compiler for Apple IIe

The C++ Compiler is a complete C compiler for the Apple IIe that generates pseudocode; it includes an assembler to convert that pseudocode to 6502 assembly language and a 6502 native code assembler. A pseudocode interpreter allows the compiler's output to be immediately tested without generating native 6502 code. The interpreter can also be used to distribute large programs more compactly if execution speed is acceptable.

C++ contains all the features of C as defined by Kernighan and Ritchie, except that floating-point arithmetic is not supported. Extensions and enhancements, such as enumerated types, structure and array

(continued)

NEW FROM BORLAND!

Borland introduces *Turbo* Lightning™ the fastest, most amazing information system since your brain

You can now find out everything in a flash. With instant access to electronic versions of the 83,000 word *Turbo* Lightning™ Random House® Speller & Word List; the 50,000-word *Turbo* Lightning Random House Thesaurus™ and the soon-to-be-released *Turbo* Lightning Encyclopedia™ — and to an astonishing array of electronic reference books which form Borland's new *Turbo* Lightning Library™.

Hitting one key on your IBM® personal computer — taps you into this new electronic age of instant information.

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No matter what program you're running, *Turbo* Lightning instantly checks your spelling *as you type*. You could be running WordStar®, MultiMate™, SideKick®, Microsoft® Word, MCI Mail®, CompuServe®, or whatever, because as you work, as you write, *Turbo* Lightning is waiting in the wings, watching how you spell every word, but not getting in the way of what you're doing.

So how does it work? Let's say the word you meant to type was "RIGHT," but you accidentally typed 'RIHGT," which is wrong. What happens then?

You immediately *hear* a '*beep*,' so you know there was a boo-boo. You instantly *see* a window, that doesn't list "RIHGT" but it does list 'RIGHT' and its sound-alike words. So your screen looks like this:

rihgt
Sound Alike Words
A: right
B: rights
C: righted
D: rightly
E: relight
F: righter
G. Add word to auxiliary dictionary
PgUp or PgDn for more words

So you move your cursor to "A," which is the right "right," hit Return and the spelling mistake is instantly fixed. And the program you were working on has continued to run while you did a little spelling sidetrip with *Turbo* Lightning. *(If you'd rather not remember your Spelling grades in school, the beep might make you nuts, but you can choose the "whole page" option. Which means that when you finish writing the entire page, any spelling mistakes will be highlighted. You go in and straighten things out straight away.)*

Lightning never goes away, is 100% concurrent, reliable, accurate and cannot, does not, will not 'crash & burn.'

Your document, letter, report, spreadsheet is word perfect and no one ever knows that you can't spell for *beens*.

***Turbo* Lightning does a lot more than spell "right" right, it also gives you instant synonyms.** Because you also have *Turbo* Lightning's Random House Thesaurus at your fingertips, you can really get to know your 'rights.' So back to the word "Right," but this time in the thesaurus. Type in "Right" and what you see in the on-screen window is:

right
Synonyms
-Adjective-
A: straight
B: true
C: accurate
D: sound
E: normal
-Noun-
F: claim
G: title
H: due
I: ownership
PgUp or PgDn for more words

So you instantly know more than one way to say, "The Boss is always right," which is handy if you get cornered and have to lie like that.

Introduce yourself to *Turbo* Lightning and it will never ever forget your name. It's conceivable, if unfair, that your name is not in the dictionary already, but you can instantly teach *Turbo* Lightning your name and all the other names and words it needs to know to help run your business or personal life.

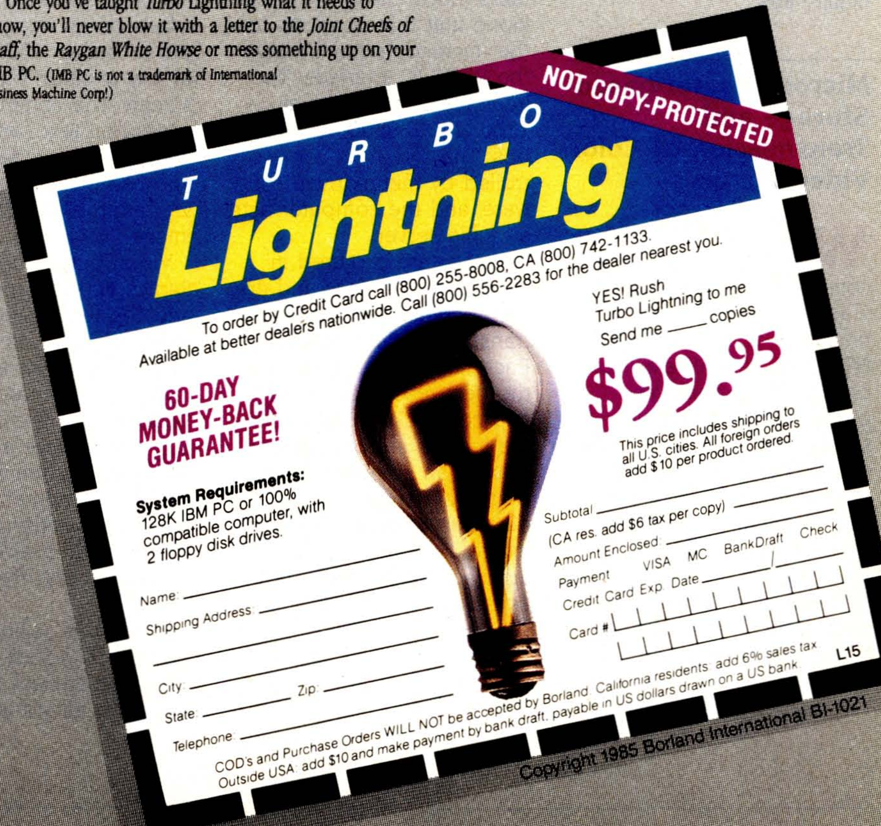
Once you've taught *Turbo* Lightning what it needs to know, you'll never blow it with a letter to the *Joint Cheefs of Staff*, the *Raygan White Howse* or mess something up on your IMB PC. (IMB PC is not a trademark of International Business Machine Corp!)

Not $500, not $400, not $300, not $200, not $100, just $99.95 for this instant electronic miracle. Our success is pretty simple. We're not greedy. We believe that it is better to sell hundreds of thousands of software programs at a reasonable price—instead of a few at prices that would make Jesse James blush.

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If you ever *write* a word, *think* a word or *say* a word, you need *Turbo* Lightning. We give you a 60-day money-back guarantee and of course there's no copy protection. $99.95 isn't much to pay for a mistake-free life. Not to mention an education. No matter who you are or what you do, you need *Turbo* Lightning. That $99.95 will be the best $99.95 you ever spent on yourself or your company.

Do yourself, your assistants, your secretary, your boss, your readers, your audience and your career a favor, get *Turbo* Lightning today!



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assignments, anchored variables, and nested functions are also included but do not interfere with compilation of standard C source code.

A proprietary operating system, C-DOS, is used so that more program space is available on disk and in memory; complete C source code for the operating system, the pseudocode interpreter, and all libraries are included. The operating system or interpreter can be incorporated in programs developed under C++ without royalty charges.

While neither C++ nor programs generated by it run directly under DOS 3.3 or ProDOS, it is possible to modify object files to run under ProDOS, according to the publisher.

C++ is available for $43.95 plus a $6 shipping charge. For more information, contact the WSM Group, Suite 241, 1161 North El Dorado Place, Tucson, AZ 85715, (602) 298-7910.
Inquiry **605.**

Microcomputer-based Storage and Transmission of Color Video Pictures

Widcom's Rapics 500 attaches to a personal computer and uses digital video-compression techniques to store and recall NTSC-compatible television color images. The compressed images can be stored (100 will fit on a standard 360K-byte floppy disk) or transmitted over a standard modem (a typical 8K-byte image can be sent in approximately 50 seconds at 1200 bps). An image can usually be compressed or expanded in less than 5 seconds.



The PC/IT *from Sperry.*

The video compression takes place inside the standalone unit that connects to the microcomputer through the RS-232C interface. The interface can operate at 1200, 2400, 9600, or 19,200 bps. The system is controlled by menu-driven software, and the computer acts as a file server.

Images are captured in 192K bytes of RAM and are then compressed using a transform-coding technique. Each image is analyzed for the best resolution, clarity, and compression ratio; simple images are compressed more than complex images. A typical compressed image occupies 8K bytes, a simple image 2K bytes, and a highly-complex image 12K bytes.

The Rapics 500 can overlay black-and-white or color labels on an image. You can put a total of 480 characters at any position on the screen. The computer-generated text overlay is handled as a separate file and can be disabled for viewing the underlying image.

Video output from the Rapics 500 is standard NTSC and can be fed into any video printer. You can capture a live off-air television image, store it, and recall it. Widcom claims the Rapics 500 can retrieve a color television picture stored on another computer system at a remote location and display it on a local television monitor in less than 10 seconds.

Widcom is selling a copy stand that includes a color television camera and zoom lens. This allows you to digitize material for the Rapics system.

General Electric Information Services helped fund the development of the Rapics 500 and also has rights to market it.

The Rapics 500 suggested list price is $4500. The optional copy stand is also $4500. Contact Widcom Inc., 1500 East Hamilton Ave., Campbell, CA 95008, (408) 377-9981.
Inquiry **606.**

Sperry AT-compatible Runs at 6, 7.16, or 8 MHz

Sperry's PC/IT Personal Computer is compatible with programs written for IBM's PC AT but is said to operate faster and support more users. Based on Intel's 8-MHz 80286 processor, the PC/IT allows switch-selection of clock speed to operate at 6, 7.16, or 8 MHz for compatibility with software designed to run using IBM's 6-MHz PC AT. You can expand the PC/IT's standard 512K bytes of RAM to 1 megabyte on the main circuit board or to 5 megabytes using two expansion cards. The system's standard 1.2-megabyte floppy-disk drive can be supplemented with one or two 44.6-megabyte hard-disk drives and a 60-megabyte tape drive.

The PC/IT comes with MS-DOS 3.1, GW-BASIC, and a diagnostics disk. As an option, you can use the XENIX System V operating system to provide support for up to eight additional users running software compatible with AT&T's UNIX System V.

The basic PC/IT with one 1.2-megabyte disk drive, 512K-byte RAM, and a

(continued)

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Feature by Feature

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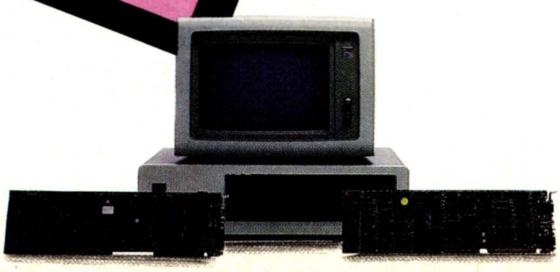
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monochrome-graphics adapter and monitor is priced at $4340. A multiuser configuration with 1-megabyte RAM, a 44.6-megabyte hard disk, 1.2-megabyte floppy disk, and a multiterminal adapter is $6834.

For more information, contact Sperry Corp., Information Systems Group, POB 500, Blue Bell, PA 19424, (215) 542-4213.
Inquiry 607.

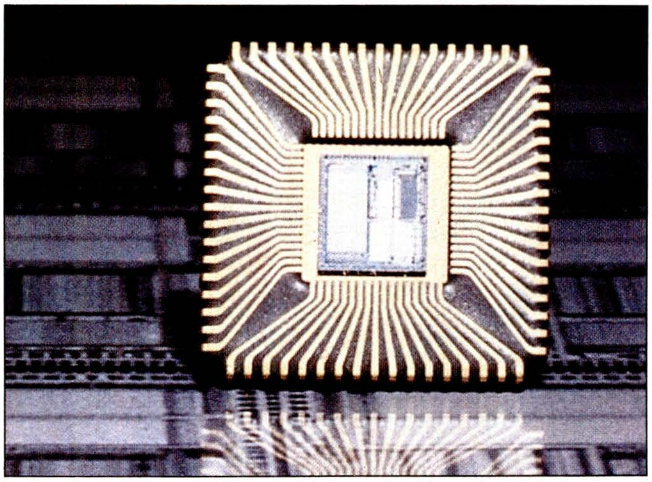
Touchpad Accessory for the IBM PC

Polytel Computer Products has introduced the Keyport 60, a small rectangular touchpad that fits along the top of the IBM PC keyboard. It has 60 touch-sensitive regions that can be programmed as function keys and defined in regular and shift modes, so the Keyport 60 will accommodate a maximum of 120 macro commands.

To record a macro, you press the Alt key on your regular keyboard and a touchpad key simultaneously. Any keystrokes that follow are recorded until you press the Alt and touchpad keys a second time.

The touchpad package comes with KPEDIT, a full-screen editor that allows you to edit key definitions.

Keyport 60 works with the IBM PC, XT, AT, and compatible personal computers, using the joystick adapter to allow concurrent operation with your regular keyboard. It costs $99. Contact Polytel Computer Products, Suite 310, 1250 Oakmead Parkway, Sunnyvale, CA 94086, (800) 245-6655; in California, (408) 730-1347.
Inquiry 608.



The first of the Transputers, the IMS T414.

Inmos Releases First Transputers

Inmos has released the first of its linkable self-contained computer chips called Transputers. Each Transputer chip holds a fast microprocessor, a small amount of memory, and four communications links for connections with external devices or other Transputers (see the May issue of BYTE, page 219). The Transputers run under a proprietary language called Occam, which can accommodate multiprocessing tasks.

The first Transputer to become available is the IMS T414, which features a 32-bit processor (executing instructions at a reported rate of 10 MIPS), 2K bytes of RAM, and four high-speed data links (10 megabits/second). A version with 4K bytes of RAM should be available soon, according to Inmos.

The T414 is sold as a single chip ($500 each in 100-unit quantities) or as part of an evaluation board. Several boards are available, including the B001-1, with 64K-byte RAM and two serial ports ($2500); the B002-1, with 1-megabyte RAM and two serial ports ($3500); and the B004-1, with 1-megabyte RAM and an IBM expansion bus connector ($3500).

To develop software for the Transputer, you need the Transputer Development System software ($4000 for the IBM PC XT version). Contact Inmos Corp., POB 16000, Colorado Springs, CO 80935, (303) 630-4000; or Inmos Limited, Whitefriars, Lewins Mead, Bristol BS1 2NP, England, (0272) 290861.
Inquiry 609.

Dot-Matrix Printers Offer Font Cartridges, IBM PC/ Epson Graphics

The MT85 and MT86 dot-matrix printers from Mannesmann Tally run at 180 characters per second in draft mode and 45 cps in near-letter-quality mode. Both printers can connect through plug-in interface modules with most popular personal computers, offer changeable typefaces in the NLQ mode, and generate sound levels below 55 dBA. The only difference between the two models is that the MT85 can print 80 columns across a page and the MT86 can print 136.

The machines are programmable from computer or interface and retain programs even when power is shut off. Full IBM PC/Epson character sets are standard. With the plug-in interface modules, the MT85 and MT86 can emulate IBM Graphics, Apple Imagewriter, and Epson FX printers. You can change the standard Quadrato typeface to Courier, Letter Gothic, or Script Italics by using the optional typeface cartridges. The printers can also produce both condensed and expanded print.

The MT85 and MT86 use standard fabric ribbon cartridges or high-carbon mylar cartridges. Both friction feed and tractor feed are standard features. The tractor feed can be adjusted to the full width of the MT86.

List prices are $499 for the MT85 (80-column) and $599 for the MT86 (136-column). Typeface cartridges are $34.95. Contact Mannesmann Tally Corp., 8301 South 180th St., Kent, WA 98032, (800) 447-4700; in Washington, (206) 251-5500.
Inquiry 610.

(continued)

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INTRODUCING THE NCR PC6.

If you don't want your business to stay small, why get a computer that does? No personal computer gives you more growing room than the new NCR PC6.

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Inquiry 262



*In Nebraska call 1-800-343-4300.

N·E·W S·E·R·V·I·C·E·S

Ordering Disks of BYTE Listings

Source-code listings in the form of text files of programs that accompany BYTE articles are now available from BYTE on disk. To order a disk of these listings for noncommercial purposes, indicate the issue (the first available is December 1985) and the kind of disk below. Enclose a check or money order in the correct amount made out to BYTE Listings. All prices include postage.

BYTE issue: ______________________

COMMON 5¼-inch FORMATS
(all cost $5 per disk in North America, $6 in Europe and South America, $7 in Asia, Africa, and Australia)

- ☐ IBM PC
- ☐ Apple II 5¼-inch DOS 3.3
- ☐ Apple II 5¼-inch ProDOS
- ☐ Commodore 64
- ☐ Hewlett-Packard 125
- ☐ Kaypro 2 CP/M
- ☐ TRS-80 Model III
- ☐ TRS-80 Model 4
- ☐ Texas Instruments Professional
- ☐ Zenith Z-100
- ☐ Atari

COMMON 3½-inch FORMATS
(all cost $6 per disk in North America, $7 in Europe and South America, $8 in Asia, Africa, and Australia)

- ☐ Apple Macintosh
- ☐ Atari 520ST
- ☐ Commodore Amiga
- ☐ Hewlett-Packard 150
- ☐ Data General/One

CP/M STANDARD 8-inch FORMAT
($6 per disk in North America, $7 in Europe and South America, $8 in Asia, Africa, and Australia)

- ☐ Single-sided single-density

OTHER FORMATS
(all cost $6 per disk in North America, $7 in Europe and South America, $8 in Asia, Africa, and Australia)

Size	Machine
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☐ 5¼-inch	______________
☐ 3½-inch	______________

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To sign up for computer conferencing among BYTE readers in Europe, write to

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Stockholm University Computing Center
Box 27322
S-102 54 Stockholm, Sweden
Telephone: 46 8 679280

The BYTECOM system includes program listings that go with BYTE articles. Send a sign-up fee using Swedish postal giro 184070-1 for the equivalent of 200 Swedish crowns (about $25) and fill in the form below. There will be an additional connect-time charge of $6 per hour for accessing BYTECOM.

Name ______________________
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City__________ State or Province __________
Postal Code __________ Country __________
Telephone ______________________

What kind of computer do you use?

____

Bulletin Boards Outside the U.S.

Listed below are some computer bulletin boards that will carry program listings from BYTE outside the U.S. Programs are for noncommercial use in connection with BYTE articles only. There are no usage charges but you must pay your own telephone charges.

CANADA

Western Canadian Distribution Center (101 11112 101st St., Edmonton, Alberta T5G 2A2) will be supplying listings to its member bulletin-board systems.

Canadian Remote Systems, Toronto, Ontario, (416) 231-9202

Edmonton, Alberta, (403) 454-6093

Meadowlark, Alberta, (403) 435-6579

Prince George, British Columbia, (604) 562-9519

Regina, Saskatchewan, (306) 586-5585

Winnipeg, Manitoba, (204) 452-5529

ENGLAND

Frank Thornley's Fido, Compulink, 0 4867 6535

NETHERLANDS

Henk Wevers' Fido, +31-8380-37156
Mr. Wevers serves as the main distribution center for 16 other Fidos in The Netherlands.

In addition, arrangements for BYTEnet Listings are being made with one or more system operators in the following nations: Australia, Canada, Chile, Denmark, England, France, Hong Kong, Ireland, Italy, Japan, Norway, Singapore, and West Germany.

Reviewed by G. Michael Vose

More than 20 years ago, John G. Kemeny and Thomas E. Kurtz created the BASIC computer language and placed it in the public domain. Now they have tried to reclaim their progeny and exert an influence on its future

able part of this book. The reminiscences of the professors reveal their excitement at the prospect of opening up to young minds the powerful potential of computing. There is in these vignettes a strong undercurrent of the "hacker ethic"—as described by Steven Levy in *Hackers: Heroes of the Computer Revolution* (Doubleday, 1984)—a need to share the

The professors make a lot of the fact that Dartmouth BASIC underwent seven major revisions but fail to note that Microsoft BASIC has seen at least six. These revisions have added significant improvements to the language's power and syntax and have even provided for true compilation. In addition, companies other than Microsoft have produced implementations of BASIC that are arguably as good as the Dartmouth versions.

The Message

Being learned men, Kemeny and Kurtz understand that BASIC's corruption was often by necessity—squeezing the language into 4K-byte and 8K-byte microcomputers required some compromises in functionality. But since today's machines impose fewer performance restrictions, the professors assert that it's time for a refurbished BASIC to take its place alongside Pascal and other respectable languages as a legitimate functional and educational tool.

That constitutes the message of *Back to BASIC*. Using example program fragments written in True BASIC, the professors argue that BASIC is a good programming language. Their arguments are well founded even if their objectivity might be questioned. The latest version of Dartmouth BASIC, the proposed ANSI standard for BASIC, and the professors' commercial version of the language are all useful and powerful programming systems.

Many people question, however, the need for versions of BASIC that differ from the widely used Microsoft version. The important issues of data-file compatibility and source-code transportability of Microsoft BASIC programs with other versions of the language concern many people who can appreciate the potential of a new BASIC but have an existing software investment to protect.

Not Convincing

Since *Back to BASIC* was apparently written in part to justify the existence of the new True BASIC and to anticipate objections to its adoption, it is surprising that the issues of compatibility and transportability between ANSI BASIC and the Microsoft version are never addressed. Similarly, Kemeny and Kurtz never discuss the relearning process that many programmers who grew up with Microsoft BASIC will have to undergo in order to adapt to the "new" BASIC.

As a result, the book doesn't convince me that an ANSI standard version of BASIC is right for me. And the space that Kemeny and Kurtz devote to espousing the message that a standard is necessary could have been put to better use by elaborating on the historical narrative of the

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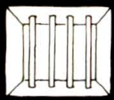
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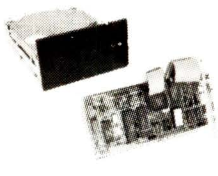
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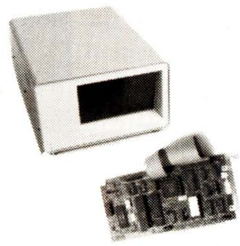
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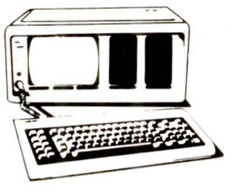
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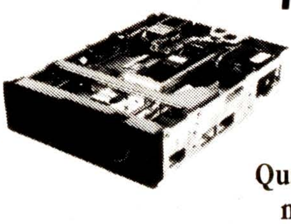


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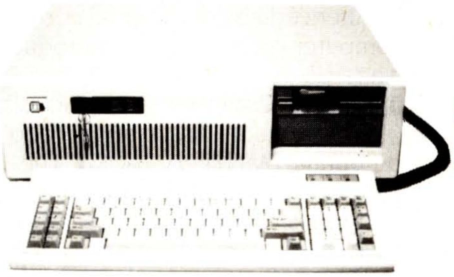


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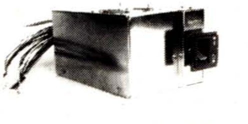
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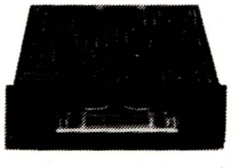


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Ad number 412

gram itself is the central legal concern. But if the system is a service, then the hospital sues XYZ for negligence. However, as Susan Nycum notes, since no human is infallible and no machine perfect, and since small programming errors with catastrophic practical consequences can go undetected until it is too late, just what constitutes negligent behavior becomes very hard to determine.

This brings up the subject of codes of conduct and moral principles in a computerized society. Formal codes have been written for computer professionals. Reproduced in *Ethical Issues* are standards of the British Computer Society, the Institute for Certified Computer Professionals, the Data Processing Management Association, and the Association of Computing Machinery (ACM). The ACM divides its principles into two categories: ethical considerations and disciplinary rules. These are further organized and subsumed by five canons. No ACM member is bound to observe the ethical considerations or the canons. Only by disregarding a disciplinary rule can a member be held accountable. But how often will all of this work?

According to disciplinary rule 5.2.1, a member of the ACM must inform employers and clients whenever "any adverse consequences to the public" may follow as a "result from work proposed to him." Sounds fine. But consider this: Since nearly all computer-related work involves being in front of a video-display terminal, and since VDTs may be hazardous to your health, then must an ACM member tell the boss that teaching the new secretary how to use the word processor may have "adverse consequences"? Strict obedience to proscriptions like this could bring automated activity to a halt. Furthermore, failure to adhere to the rules may bring "expulsion," "suspension," or "admonition." Even if an individual is caught violating a disciplinary rule, the punishment might amount to little more than the proverbial slap on the wrist.

In a brilliant series of thoughts entitled "Professional Ethics: An Intellectual and Moral Confusion," John Ladd points out that codes of conduct may actually do more harm than good. Ethical codes are necessarily minimal; they formulate *the least* that needs to be done. This may incline professionals to *not* do their best but do just what the code requires. Perhaps worse, codes of conduct can stifle the dissenter, the critic, or the creative person and degenerate into that situation John Stuart Mill called the "tyranny of the majority."

Throughout this book, question follows question as opinions diverge in what Johnson and Snapper term "an interval of uncertainty" brought about by the new technology and occupied by a dense intellectual pluralism. It is just this tolerance of so many different points of view in a single volume that makes *Ethical Issues in the Use of Computers* a valuable and commendable book.

Stan Czarnik is a teacher, musician, and technical specialist. He works at Information Access Company (The Computer Database, 2265 Carlson Dr., Suite 5000, Northbrook, IL 60662).

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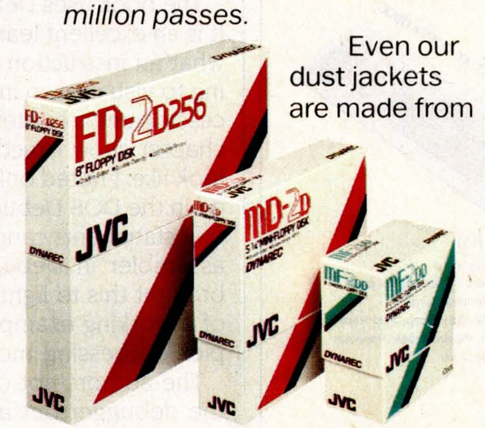
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BOOK REVIEWS

IBM PC/8088 ASSEMBLY LANGUAGE PROGRAMMING
Reviewed by Larry Clark

The primary reason I bought a PCjr was to develop a threaded interpretive language similar to FORTH. I soon discovered that the 8088's use of segmented memory addressing introduced new ideas that I could not readily grasp from the terse, though complete, assembler manuals. For learning 8088 assembly language, I needed a more complete explanation. Avtar Singh and Walter A. Triebel's *IBM PC/8088 Assembly Language Programming* provides that kind of explanation.

This book's format is "goal directed"—at the beginning of each chapter, the authors outline the ideas to be covered in order to keep the reader aware of educational goals that lie ahead. They try to give the beginning assembly-language programmer a good, useful understanding of the 8088. The reader needs a basic mathematical background to understand the binary and hexadecimal math sections.

Programmers who need the speed that 8088 assembly-language programs offer will find this book valuable. It starts with a discussion of binary and hexadecimal arithmetic. In a lucid review of basic machine language, Singh and Triebel do an especially good job of convincing the reader that hand-coding can be done but is not to be tackled for large programs. The majority of the text follows with an introduction to 8088 assembly-language programming and debugging. The text refers to the IBM version 1.0 assembler, but my version 2.0 assembler performed with no detectable errors; a non-IBM assembler may do as well, provided it handles standard mnemonics and IBM pseudo operation codes.

You'll need Debug, the assembler's linker, and enough memory for the assembler. I recommend two disk drives; otherwise, you'll have to swap disks frequently.

The book uses Debug, a PC-DOS utility, in the examples. It is an excellent learning tool. Debug traces show exactly what an instruction does and so relieves readers of having to visualize an instruction's effect on CPU (central processing unit) register contents. Listings contained in each chapter show exactly what each debugging session will look like. I noted only one omission here that was provided in the DOS Debug manual—some of the Macro assembler statements cannot be assembled with the line-by-line assembler in Debug. Only one or two of my sessions brought this to light, and that was after I left the bounds of a working example and tried some of the more complex addressing modes.

The authors not only include examples of how to use the debugger but also demonstrate how to use the assembler and linker. A session on the use of the EDLIN editor will probably go unused, as most readers will prefer to use a full-screen editor instead.

An optional disk contains a copy of the book's machine-run examples. A note in the book says the disk can be

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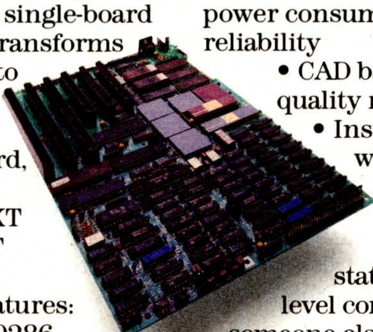
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purchased separately for $24.95. I recommend that you buy the disk because it will save you time and quicken the learning process. I found only one discrepancy between the disk and the book.

The examples in the text are generally short and might not take more than one or two iterations to correct. But there are 31 examples; it is not hard to imagine being so slowed down by entering programs that you don't finish the last chapters, which are the most interesting.

This is a thorough text that delivers the fundamentals of 8088 programming. The questions at the end of each chapter served as a gauge of how well I understood the material. Working examples consist of a source listing, assembler output, and a complete Debug session. You should have no trouble duplicating the results given in the text when the proper tools are used.

I found only two obvious errors, but neither stood in the way of learning about the 8088. On page 55, the authors say that index registers are always combined with the DS (data segment) register. The iAPX 88 user's manual disagrees with this, saying the DI index register is limited to the ES (extra segment) register instead. Second, the contents of the CS, DS, ES, and SS registers listed in the Debug sessions never matched those on my PCjr. Apparently the Debug program can adjust the segment at which a program resides according to the memory available. I learned in the text that the 8088 supports relocation by means of segmentation, which could explain why the programs worked even though they were placed in memory locations different from those described by the authors.

The 8088 instructions are explained in groups of similar instructions, and the simpler instruction groups are followed by the more complex types. Among the more interesting examples are the looping instructions similar to those found in high-level languages.

IBM PC/8088 Assembly Language Programming is more than 400 pages long and is very thorough, but it does not review macro programming, nor does it completely cover the pseudo-ops the assembler is capable of using.

The examples not only demonstrate key features and capabilities of the 8088's assembly language but provide sample sorting routines and floating-point math routines as well. The math programs are good introductions that are extremely interesting. All routines are designed to be reused by the reader in later programming projects. One set of examples deals with simple input/output calls to PC-DOS; other examples deal with the timer chip in the PC.

The book helped me learn to program the 8088 because of its organized approach and extensive examples. This is a good introductory text on 8088 assembly-language programming. I recommend it if you're ready to plunge into this challenging branch of microcomputers. ■

Larry Clark (8103 Thornewood Dr., Hixson, TN 37343) works in microcomputer systems development and is a robotics instructor.

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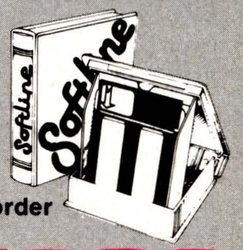
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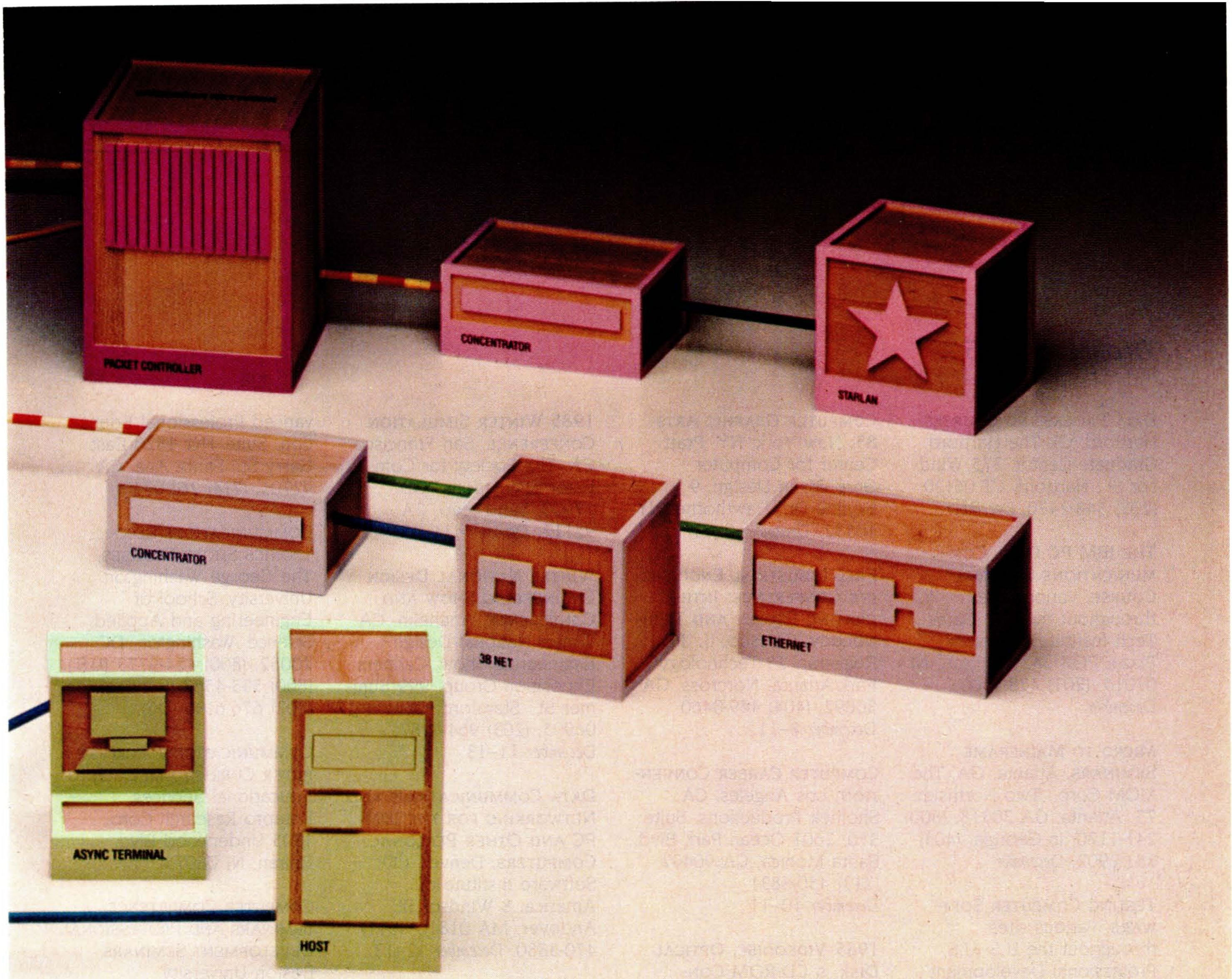
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December 1985

DATA PROCESSING COURSES, Hartford, CT. The Hartford Graduate Center, 275 Windsor St., Hartford, CT 06120, (203) 548-2470. *December*

THE IBM PC DATA COMMUNICATIONS SURVIVAL COURSE, various sites throughout the U.S. Data-Tech Institute, Lakeview Plaza, POB 2429, Clifton, NJ 07015, (201) 478-5400. *December*

MICRO TO MAINFRAME SEMINARS, Atlanta, GA. The MOM Corp., Two Northside 75, Atlanta, GA 30318, (800) 241-1170; in Georgia, (404) 351-2902. *December*

TESTING COMPUTER SOFTWARE, various sites throughout the U.S. U.S. Professional Development Institute, 1620 Elton Rd., Silver Spring, MD 20903, (301) 445-4400. *December*

OFFICE AUTOMATION DESIGN & MANAGEMENT, various sites throughout the U.S. Thomas Wilds Associates Inc., POB 11120, Greenwich, CT 06830, (212) 986-2515. *December–March*

SECOND ANNUAL WASHINGTON, DC, EASTERN SIMULATION SYMPOSIUM: WHAT'S NEW IN SOFTWARE, Crystal City, VA. The Society for Computer Simulation, POB 2228, La Jolla, CA 92038, (714) 459-3888. *December 3*

SECOND ANNUAL BITS & BYTES NATIONAL COMPUTER SHOW, Dallas, TX. Information Processing Group, Suite 305, 87 North Raymond Ave., Pasadena, CA 91103, (818) 792-5111. *December 6–8*

COMPUTER GRAPHIC ARTS 85, New York, NY. Pratt Center for Computer Graphics in Design, 9 Skyline Dr., Hawthorne, NY 10532. *December 8–11*

FALL INDUSTRIAL ENGINEERING CONFERENCE: INTEGRATING PEOPLE AND TECHNOLOGY, Chicago, IL. IIE Registrar, 25 Technology Park/Atlanta, Norcross, GA 30092, (404) 449-0460. *December 8–11*

COMPUTER CAREER CONVENTION, Los Angeles, CA. Shomex Productions, Suite 310, 2601 Ocean Park Blvd., Santa Monica, CA 90402, (213) 450-8831. *December 10–11*

1985 VIDEODISC, OPTICAL DISK, & CD-ROM CONFERENCE AND EXPOSITION, Philadelphia, PA. Meckler Publishing, 11 Ferry Lane W, Westport, CT 06880, (203) 226-6967. *December 10–12*

HI TECH UPDATE '85, Ottawa, Ontario, Canada. Conference Coll Inc., 1138 Sherman Dr., Ottawa, Ontario K2C 2M4, Canada. *December 11–12*

DEXPO WEST 85: THE EIGHTH NATIONAL DEC-COMPATIBLE EXPOSITION, Anaheim, CA. Expoconsul International Inc., 55 Princeton-Hightstown Rd., Princeton Junction, NJ 08550, (609) 799-1661. *December 11–13*

1985 WINTER SIMULATION CONFERENCE, San Francisco, CA. The Society for Computer Simulation, POB 17900, San Diego, CA 92117. *December 11–13*

WINTER NATIONAL DESIGN ENGINEERING SHOW AND CONFERENCE, Anaheim, CA. Winter National Design Engineering Show, Cahners Exposition Group, 999 Summer St., Stamford, CT 06905, (203) 964-8287. *December 11–13*

DATA COMMUNICATIONS AND NETWORKING FOR THE IBM PC AND OTHER PERSONAL COMPUTERS, Denver, CO. Software Institute of America, 8 Windsor St., Andover, MA 01810, (617) 470-3880. *December 12–13*

FIRST INTERNATIONAL CONFERENCE ON SUPERCOMPUTING SYSTEMS, Tarpon Springs, FL. Supercomputing Conference, POB 639, Silver Spring, MD 20901, (301) 589-8142. *December 16–20*

Catalogs and brochures for upcoming courses and seminars are available from the following:

CATALOG OF PERSONAL COMPUTER COURSES, American Management Association, 135 West 50th St., New York, NY 10020.

CENTER FOR ADVANCED PROFESSIONAL EDUCATION SEMINARS, Center for Advanced Professional Education, Suite 110, 1820 East Garry St., Santa Ana, CA 92705, (714) 261-0240.

COMMUNICATIONS/ELECTRONICS SHORT COURSES, The George Washington University, School of Engineering and Applied Science, Washington, DC 20052, (800) 424-9773 (U.S.), (800) 535-4567 (Canada), or (202) 676-6106 (DC).

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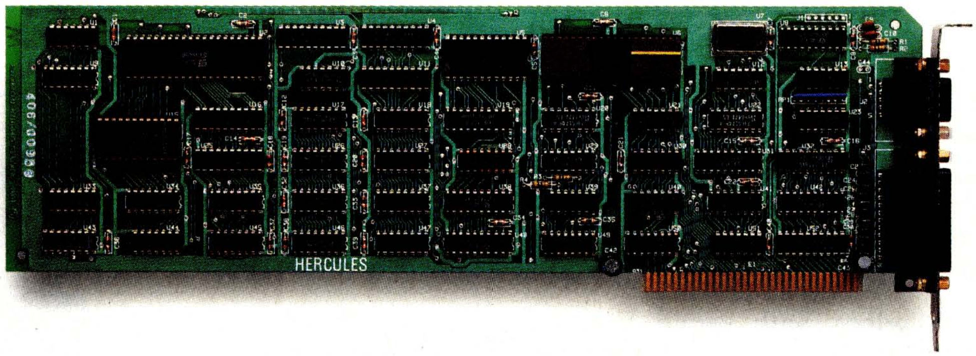
COURSE CALENDARS, Integrated Computer Systems, 6305 Arizona Place, POB 45405, Los Angeles, CA 90045, (213) 417-8888.

DIGITAL CONSULTING ASSOCIATES INC. SEMINARS, Software Institute of America Inc., 8 Windsor St., Andover, MA 01810.

INFORMATION PROCESSING SERIES, QED Information Sciences Inc., QED Plaza, POB 181, Wellesely, MA 02181.

INTENSIVE SEMINARS FOR PROFESSIONAL DEVELOPMENT, Worcester Polytechnic Institute, Office of Continuing Education, Higgins House, Worcester, MA 01609, (617) 793-5517. ■

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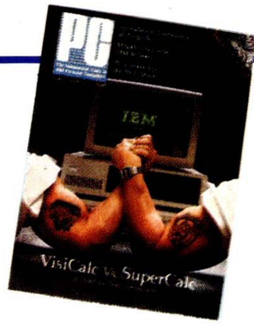
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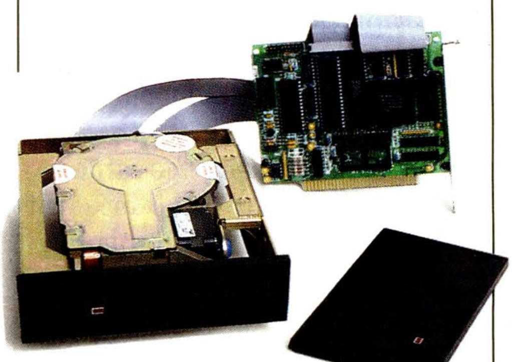
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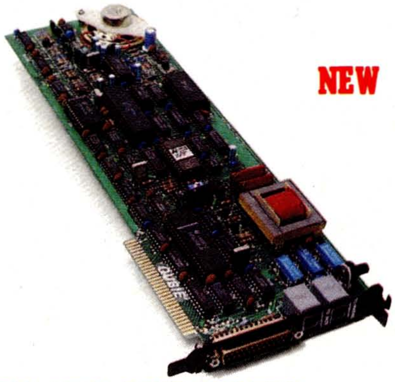
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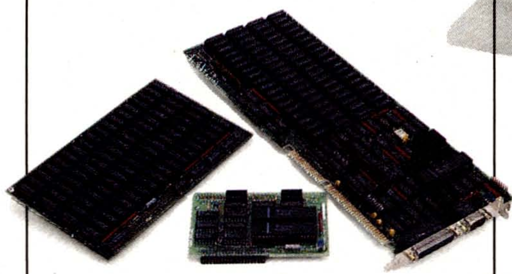
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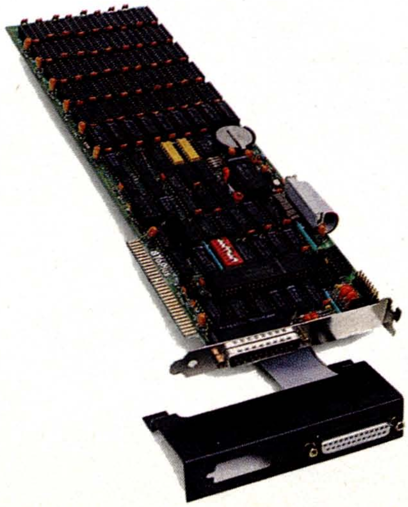
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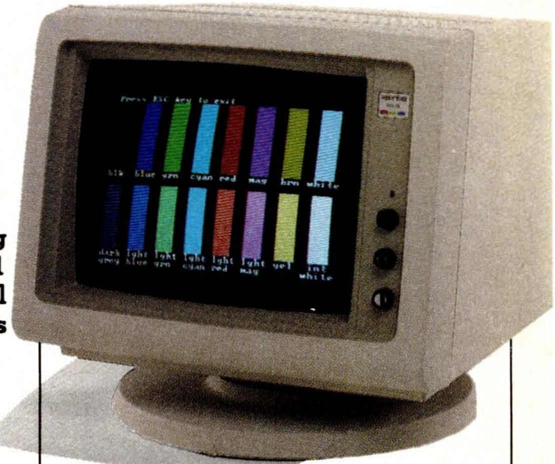


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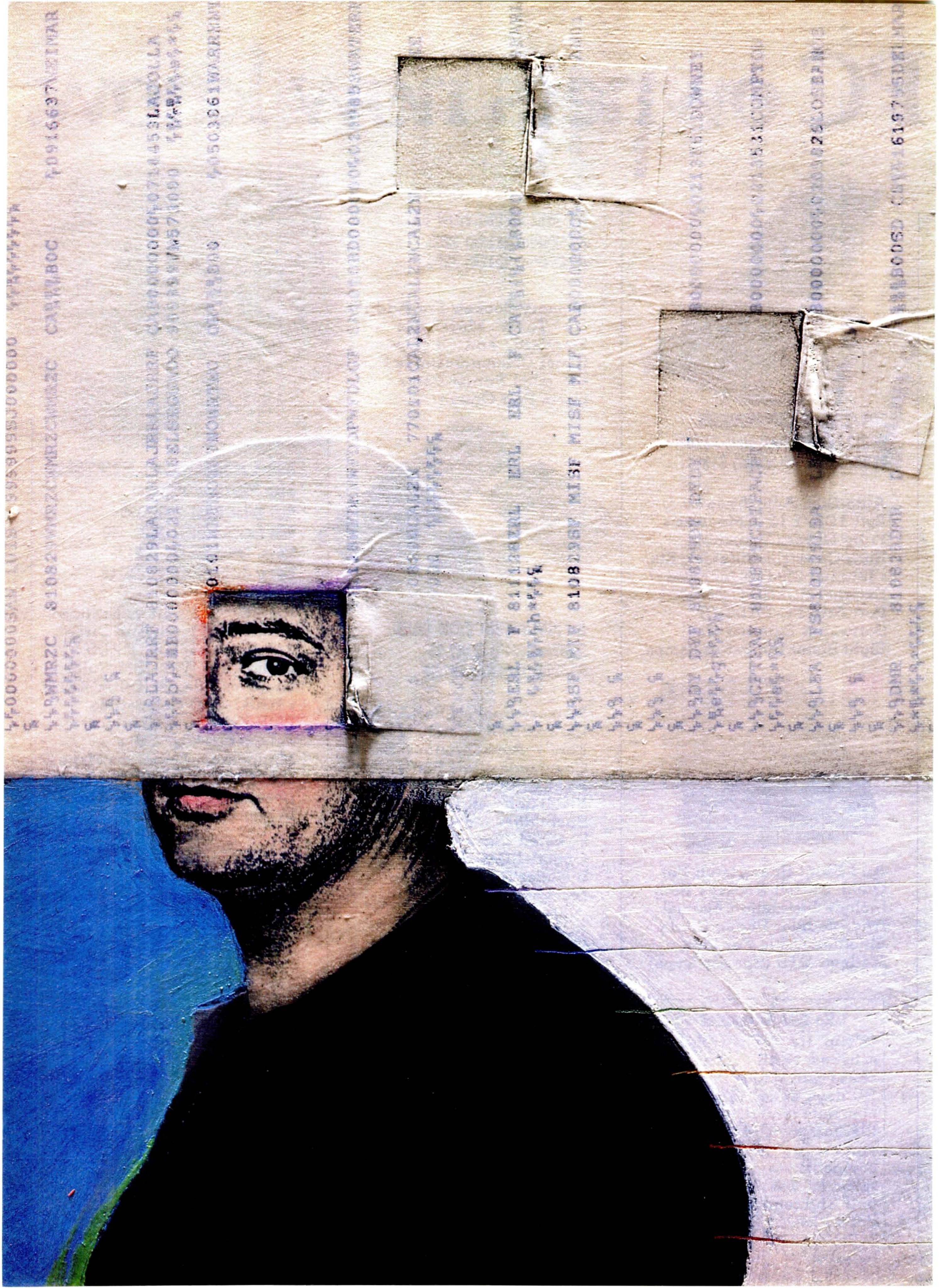
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Features

IN THE CIRCUIT CELLAR this month, Steve gives us a state-of-the-art bulletin-board system. This particular BBS is made up of his last two projects: the SB180 single-board computer (September and October) and the MOSART chip from Xecom (November). This month's article is both a tutorial on bulletin boards and a functional expansion for people who have built the SB180. Incidentally, BYTE is setting up an SB180 bulletin-board system for internal use.

This month Jonathan Amsterdam begins his three-part series on the construction of a compiler for a high-level language. This first part deals with the basics of the compiler, including a description of SIMPL, his programming language.

A visit to Fort Worth, Texas, gave BYTE's Mike Vose a chance to see two recent releases from Tandy. The Tandy 600 is a portable with the features users of the Model 100 and Tandy 200 most often requested: more memory, a disk drive, and an 80-column screen. The Tandy 3000 is an IBM PC AT clone that Tandy claims is faster, and it is priced as low as $2599.

English is hardly ever used to communicate with computers. This is unfortunate, because English can be very effective; it gives you a variety of ways to express compiler actions with a minimum of training and program interaction. In "English Recognition," Roy Kimbrell describes how you can apply understanding to an application.

John Nash tells us to consider three things when trying to choose scientific applications software: the purpose of the package, the style in which it's presented, and its overall quality. He also provides a list of various sources of information to help us in our search.

C. R. J. Currie describes a technique for handling files with record lengths that are more than a sector on Microsoft BASIC systems. If your system can automatically handle variable-length records of a size less than the system's maximum, you can use this technique. It works well on both 8-bit and 16-bit versions of Microsoft BASIC.

"Travesty with Database" is the third travesty-generator program that we have had since November 1984 when we ran the original, "A Travesty Generator for Micros" by Hugh Kenner and Joseph O'Rourke. This new version, which the author has named Breakdown, is written in Turbo Pascal, and it improves performance and avoids rereading the input text by storing the frequency information in a database.


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BY STEVE CIARCIA

A functional cost-effective expansion for those who have built the SB180

You might have noticed that the theme of this issue is computer conferencing. It is no mere coincidence that this month's Circuit Cellar project has something to do with communication. Since I have just finished presenting the SB180 single-board computer and a single-chip modem as separate projects, it is only natural to combine the two to produce something grander.

The concept of electronic messaging and information exchange has been revolutionized by low-cost computers. Not too long ago, only expensive mainframes could function in such a capacity. Now, any computer with a disk drive and a modem can be configured to perform basic communication functions.

The most typical personal computer communication configuration is the electronic bulletin-board system (BBS). While I will explain it in greater detail later, a BBS is designed to exchange messages, data, or programs. It can be either public or private.

While the quality of the information being exchanged sometimes comes into question, bulletin boards serve a useful function that could not otherwise be performed without great expense. I like to think of them as a 24-hour answering service that says more than "Sorry, can I take a message?" Callers with the proper access authority can receive private information left only for them, perform tasks within the computer system, and leave messages for specific third parties who will also call the BBS.

Computer experimenters discovered the entertaining aspects of bulletin boards years ago. However, such versatile message-listing and information-retrieval systems have now assumed important business applications. For example, field service and sales personnel away from the office now have a way to stay in contact. Or the workday customer-service line into the company can become a BBS after hours so that customers feel attended to on a full-time basis.

The limiting factors in business use of bulletin boards, either public or private, have been price and start-up effort. While a minimally configured computer with BBS software and a modem can be assembled for about $2500, you still have to gather the components and integrate the software. With few exceptions, the concept of a truly turnkey BBS has not emerged. Because

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most BBS software is generic rather than designed for a specific hardware configuration, you must port the BBS software and install the device drivers for your system's peripheral devices. The real definition of the words "port" and "install" is time. When the hardware configuration and the software operating system are explicitly known, it is much easier to build a turnkey BBS.

This month, I'm combining the SB180 single-board computer, presented in the September and October issues, and Xecom's MOSART chip, described in last month's column. When combined with some fancy software, these two projects become a state-of-the-art turnkey BBS.

The MOSART and associated components are mounted on a printed-circuit board that plugs into the SB180's I/O (input/output) expansion bus and is called a COMM180 expansion board. This MOSART-based BBS, unlike most others, can understand Touch-Tone inputs and give voice responses.

Unlike the COMM180 BBS software (explained in detail later), which is specific to the SB180, my discussion and descriptions are intended to be somewhat generic. You may or may not decide to build the exact BBS I am outlining, but you will gain some benefit by understanding the salient points of BBS configurations. This particular BBS requires a minimum of computer knowledge.

To give you some real-time evaluation of its capabilities, I have installed a working SB180/COMM180 BBS in Connecticut that you can call for a demonstration. If you like this direct line to me and there aren't thousands of messages to answer, I will establish it as a continuing Circuit Cellar BBS where you can get past, present, and future project information. More on this later.

TURNKEY BBS

The primary difference between an SB180/COMM180 system and any other lies in the unique combination of hardware and software being used. I intend this article both as a tutorial on bulletin boards and as a functional cost-effective expansion for those of you who have built the SB180. You may elect to not use the prepackaged bulletin-board software that I will describe and instead use software available in the public domain to set up a bulletin board. That is a viable option. However, the Term III/Z-MSG software is available preconfigured for the SB180/COMM180 combination and can be run out of the box.

Essentially, this software is a turnkey electronic mail and file-transfer system. To use it, you merely place the disk into your SB180/COMM180 computer system, turn on the terminal, hook up a telephone line, and give it some electricity. You then make your decision as to what you want to use the bulletin board for.

Naturally, you can personalize the system to a large extent if you want. Since the software is modular, adding or deleting modules will let you configure any desired functions. Before getting down to details, let me first discuss a few more features of the Circuit Cellar SB180 turnkey bulletin-board system (TKBBS).

TKBBS FEATURES

The features are grouped into four major areas: electronic mail, file transfer, voice response (not voice recognition), and DTMF (dual-tone, multiple-frequency) control.

Electronic mail provides the capability of leaving messages for other people. Messages, which usually consist of ASCII (American Standard Code for Information Interchange) characters, are made up of a sender's name, addressee's name, subject, and message text. Sending someone an electronic message is similar in principle to sending them a letter.

File transfer is a technique for the transmission or reception of files and is usually referred to as downloading and uploading from the point of view of the TKBBS. The TKBBS will support file-transfer protocols like XMODEM, Kermit, CIS (CompuServe), and XON/XOFF. Until now, it was highly improbable that this wide selection of protocols would be available in one software package, but the TKBBS has them all.

Finally, the voice-response feature of the Xecom 1203 MOSART internal LPC (linear predictive coding) speech synthesizer is available for your use as well as a wide variety of DTMF-decoding functions of the MOSART.

A LITTLE HISTORY

A short history lesson will help us appreciate what it takes to make a turnkey bulletin-board system. The TKBBS traces its roots back to the first computerized bulletin-board system. Although access to computers via telephone lines and modems has existed for 20 years or so, this had been done only for time-sharing mainframe computers and the military until personal computers appeared. Personal computers made their debut in the middle 1970s, based on the Intel 8080 microprocessor and others. In 1977, Ward Christensen became interested in using a modem with his personal computer. He wrote an assembly-language program called MODEM, which allowed a microcomputer to send and receive characters via the modem and telephone line. This was during the time when modems usually ran at 110 bits per second (bps), and a 300-bps modem was considered fast.

MODEM was a program intended to be operated by a person—nothing about it was automatic. It also incorporated a protocol for transferring files. This protocol would send a file 128 bytes at a time. Because telephone lines are subject to transmission errors, it ensured that each 128-byte block was received properly by the destination. If an error was detected in a 128-byte block, that block was retransmitted until the receiver detected no errors.

MODEM was placed in the public domain, where it was eventually enhanced by other people, becoming MODEM7. To this day, the popularity and widespread acceptance of the file-transfer protocol embodied in the original MODEM can be traced to Christensen's placing the program in the public domain. And the prece-

dent of placing communications software in the public domain has been followed to this day by many authors.

Dave Jaffe, meanwhile, envisioned another use of his personal computer for communications. Instead of a situation where two people used MODEM on each computer, he pictured a scenario where an unattended computer could be accessed by a person using MODEM. When accessed, the unattended computer would let the caller access the CP/M operating system. Callers would be able to perform all the functions supported by CP/M as though they were with the unattended computer, even though they could be anyplace in the world that had telephone lines. The result of his work in this area was an assembly-language program called BYE.

After Jaffe wrote BYE, Christensen began work on yet another program, this one intended to function as a message system. Its purpose was to let callers accessing a computer using BYE leave messages for other callers or the owner of that computer. The resulting program was named CBBS, which stands for computer bulletin-board system. He saw it as the electronic equivalent of the bulletin board in a supermarket or other public place.

With these three programs, Christensen and Jaffe invented the BBS. Another significant early development was a program called XMODEM by Keith Petersen, which let the unattended computer using BYE send and receive files using the protocol implemented in MODEM. This protocol is more widely known today as the XMODEM protocol, although it has been referred to as the Christensen protocol or MODEM protocol with equal validity.

TODAY'S PUBLIC DOMAIN

Bulletin boards have progressed considerably beyond those first implementations. One of the significant changes has been the introduction of security to the bulletin-board software. In the first implementations of BYE, all the commands of CP/M were available to anyone calling the system. Thus, anyone could erase a file. This allowed unauthorized users to penetrate bulletin boards, and system integrity became an important issue.

The first elements of security were added by introducing ZCPR1, an early forerunner of ZCPR3. Ultimately, many other sysop (system operator) and user functions were added. Among them, BBS software now keeps track of time, which prevents visitors from overstaying their welcome. This means that the system can limit a user's access to a length of time determined by the sysop.

Early versions of BYE required extensive programming knowledge and expertise in the inner workings of CP/M. It has evolved into a program that uses advanced software techniques but is much easier to set up. Although BYE remains somewhat complicated and could not be recommended for a novice user, it has been extensively enhanced and is an excellent example of the powerful software available in the public domain.

XMODEM also has been enhanced significantly, and it currently logs file-transfer activities and prevents certain types of system security compromises.

The concept of a message system first introduced by CBBS has been greatly improved. Modern message systems allow both private (can be read only by the sender and addressee) and public (anyone can read) messages. Configuration information about the caller—like how many characters per line can be displayed, privileges while logged onto the system, and more—is recorded along with the name and password. Extensive menu structures can be created or changed without requiring recompilation or reassembly of the message-system program itself. Categories of users can be defined separately, with each category having different privileges when logged onto the system.

Modems have also evolved significantly since 1977. The transmission rate has increased from 110/300 bps to 2400 bps, with the hardware cost remaining the same. Also, modems are considerably more intelligent, with the ability to determine the stages of call progression and report them back to the computer or the user as well as dialing the desired telephone number.

A significant change to bulletin-board software has been the introduction of security.

And last, but not least, have been the corresponding improvements in the software run by callers on their own computers when calling other computers running BYE and XMODEM. These programs take the place of the original MODEM. Currently available programs, like MDM740 by Irv Hoff or MEX by Ron Fowler, possess advanced features like automatic redial until connection is established, printer buffering for slow printers, and much more.

The programs mentioned in the preceding paragraphs are available for the price of a telephone call from many of the thousands of bulletin boards across North America. It is quite possible for SB180 owners to put together their own BBS using these programs, if they have the appropriate technical expertise.

I did not use public-domain software in the SB180 TKBBS because this is a "how to" article instead of a "what if" article. As such, I am under certain legal restrictions.

My overriding determination is to provide a true turnkey system that supports the best features of the SB180 and the MOSART and can be easily implemented by software novices like me. I don't have the time to delve into the inner workings of various communication packages and port them to my computer ("port" is the hackers' word for withdrawing from society while integrating a piece of copied software). There's a point in the evolution of bulletin boards where

(continued)

we simply want to take it out of the box and plug it in.

Most of the public-domain BBS programs are intended for generic computer systems and would not directly support the MOSART on the COMM180 (they will if you use a stand-alone modem plugged into the SB180's modem port). To use them, I would have to modify the original software and distribute the new routines to the public through the Circuit Cellar.

Support to this degree unfortunately presents a legal problem. While we all think of public-domain software as free, that is not a license for it to be copied and distributed. Like the software I frequently supply with articles, authors often copyright their work but allow end users to make one copy of it for their "personal and noncommercial use." By modifying and distributing thousands of copies of so-called public-domain software, I might overlook someone's copyright and find myself in a legal jam.

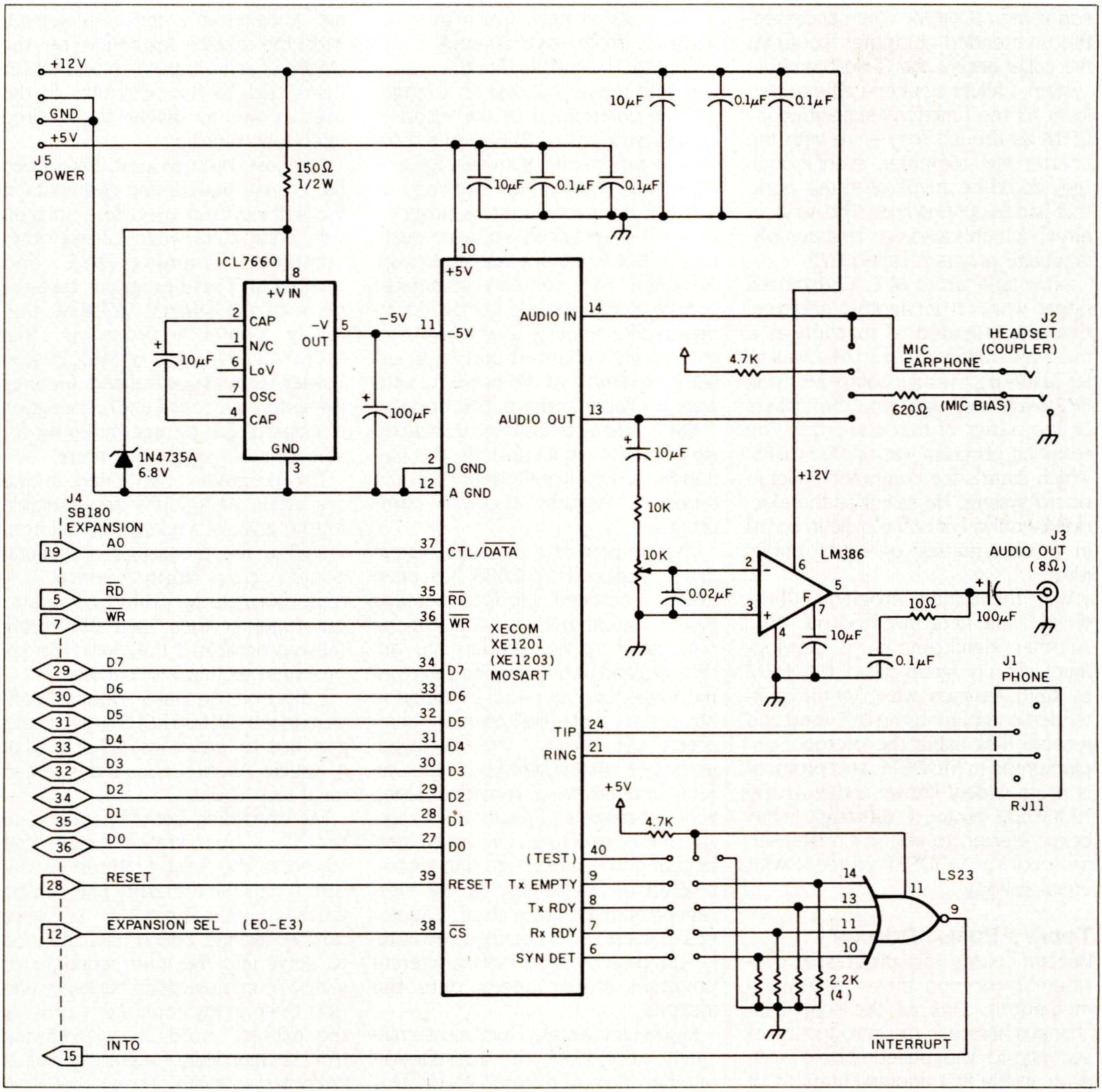


Figure 1: *The schematic diagram of the Circuit Cellar* COMM180 *modem expansion board.*

Intelligent individuals with more than modest software knowledge should not be deterred from doing what I cannot. By all means, download CBBS or some other software and use it on the SB180. Being CP/M-compatible, the SB180 should require virtually no modification if you implement the BBS with a Hayes (or Hayes-compatible) modem. Unfortunately, for me the only preventive measure is original composition and absolute knowledge of the distribution license. For that reason, Term III and Z-MSG have been specifically adapted to support the SB180/COMM180 BBS.

What Is a BBS For?

Public bulletin boards have generally specialized in certain areas. Examples are systems specializing in the uploading or downloading of public-domain software, systems for the private use of a computer club or user group, or even computerized dating! These are major divisions, with a wide spectrum of possibilities within each. A system specializing in the uploading and downloading of software may specialize yet further and concentrate on programs written in the C language for 8-bit computer systems.

Many magazines, including BYTE, use bulletin boards to deliver programs detailed in articles. As long as you possess a modem, you can avoid the tedium of manually typing program listings. Magazines also use bulletin boards as a collection point for authors' submissions. Jerry Pournelle mentions transmitting his column to BYTE via modem. The advantage of not having to cope with the delays of the mail more than makes up for the cost of the telephone call.

Even some radio stations have bulletin boards where listeners can leave song requests and other messages.

Some public commercial bulletin boards have appeared. Often, computer stores configure an in-house microcomputer as a bulletin board, promoting products and services. Although commercial possibilities for bulletin boards exist, the single-user nature of most personal computers limits how many callers can be handled, and there are restrictions as to what the caller might do on the system once access is granted.

An alternative to a public system is a private system with limited access. An example of this is an employee who uses a terminal or computer at home to work on a computer at the office. Another one is the after-hours messaging or order-entry system. With access limited to a relatively few suppliers and customers, communication is maintained at all times.

The SB180 TKBBS will operate in either a private or public mode.

Legalities

Private systems are likely to become popular due to the unfavorable legal atmosphere regarding bulletin boards. This has resulted from misuse of public bulletin-board systems by people known as "phreaks," "pirates," "worms," and "crackers." Phreaks defraud the telephone company of toll charges through a variety of schemes. Pirates use bulletin boards to exchange information on how to illegally duplicate copyrighted software. Worms and crackers break into other computers to access confidential files and destroy information. These activities have spurred many state legislatures and the U.S. Congress to pass a variety of laws aimed at restricting the activities of bulletin boards (an extensive discussion on this topic, complete with voluminous source data, is available on BIX under "BBS/other" and "tele.policy" conferences).

Many of these laws make the person who operates the BBS responsible for all activities that occur on the system. One result of this has been that not many systems are open to first-time callers. Many operators of bulletin boards now require that people register for access. This usually involves some sort of verification that the person is not operating with a phony name and that the person provides a real address and telephone number. If a caller does perform some illegal activity, the sysop can refer appropriate law enforcement officials to that caller. Nearly all sysops have no intention of engaging in illegal activities, and these measures are their way of protecting themselves. You should bear these legalities in mind

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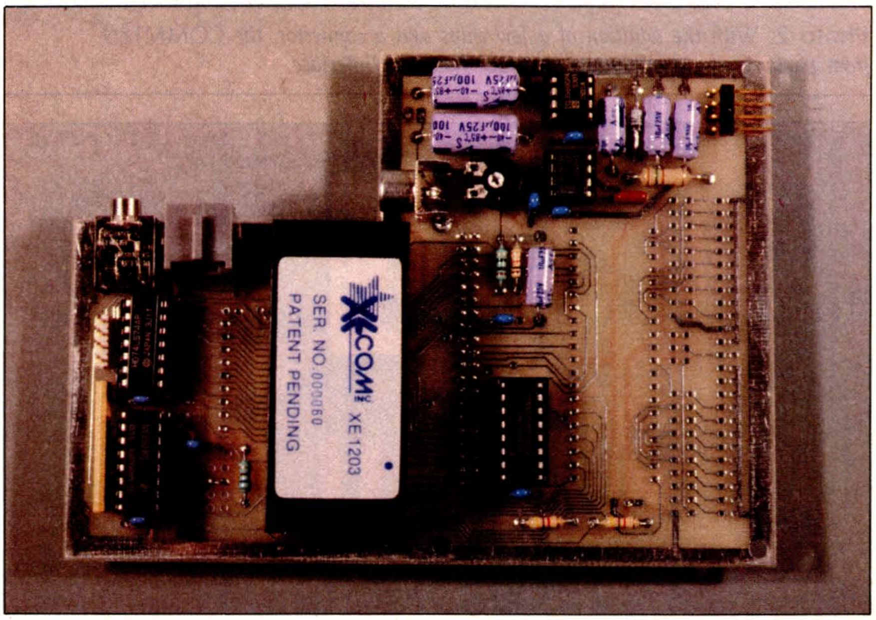


Photo 1: *A prototype of the* COMM180 *expansion board, shown here populated with the* MOSART *communications chip and its supporting circuitry.*

if you intend to operate a public system.

THE TKBBS

The hardware of the TKBBS consists of the SB180 single-board computer; the COMM180 expansion board containing the MOSART; two disk drives capable of storing approximately 1600K bytes; and an enclosure, power supply, and necessary cables. The software of the TKBBS includes the Z-System (see the October Circuit Cellar). Also included are the two software packages that make up the core of the TKBBS: Term III and Z-MSG.

Because the hardware components and the Z-System were extensively discussed in previous Circuit Cellar articles, I will discuss them only briefly here so that the BBS software can be discussed in further detail.

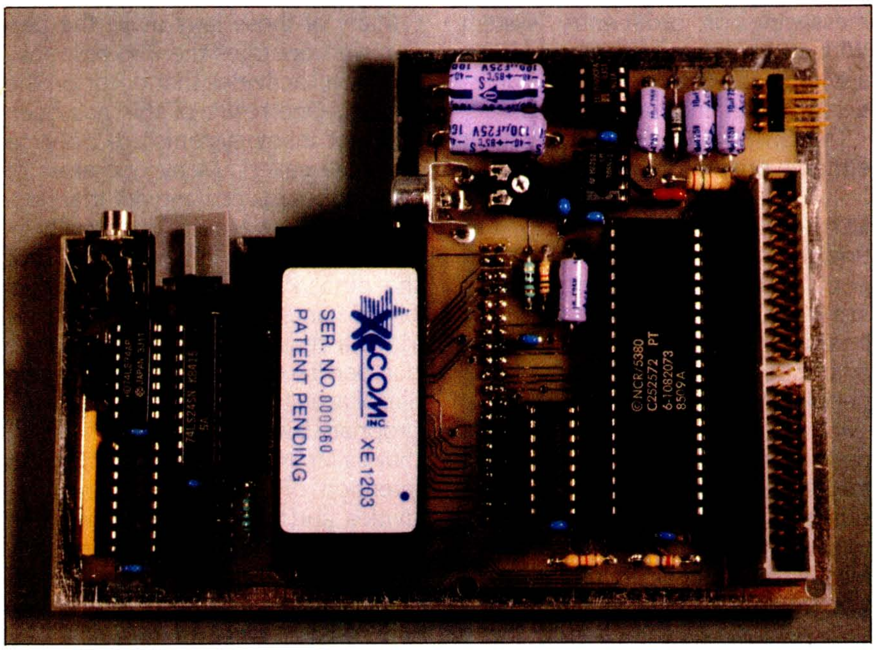


Photo 2: *With the addition of a few chips and a connector, the* COMM180 *from photo* 1 *can also support an* SCSI *hard-disk interface.*

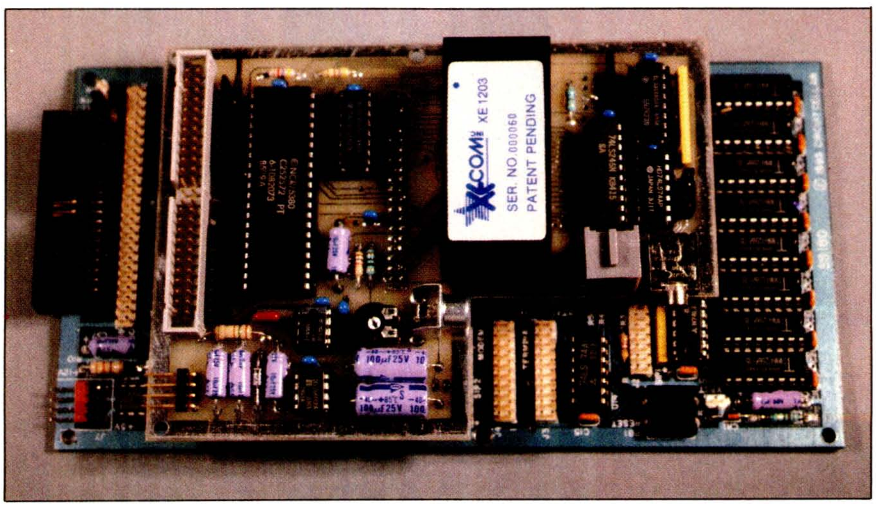


Photo 3: *The* COMM180 *modem/SCSI board rides piggyback on the* SB180 *single-board computer, connecting via the* SB180's *expansion* I/O *connector.*

THE SB180

The SB180 is a single-board computer based on the Hitachi HD64180 microprocessor, which is upward-compatible with Z80 software. The SB180 contains 256K bytes of RAM (random-access read/write memory); two serial ports; an SMC 9266 floppy-disk-controller chip that handles 3½-, 5¼-, and 8-inch drives (concurrently); an 8K-byte monitor in EPROM (erasable programmable read-only memory); a Centronics-compatible parallel printer port; and an I/O expansion bus. This all fits on a circuit card that measures 4 by 7½ inches (the size of a 3½-inch disk drive). I described the SB180 hardware extensively in the September Circuit Cellar.

COMM180 EXPANSION CARD

The COMM180 expansion card, shown in figure 1, consists of the MOSART and a few other components. The XE1203 MOSART chip, discussed in great detail in last month's Circuit Cellar, is a 300/1200-bps modem with DTMF-decoding and speech-synthesis capabilities. It is unique in that it incorporates all these functions into one small device, 2 square inches, designed to interface directly into the data bus of a microprocessor (see photo 1).

The MOSART operates on +5 and −5 volts. The +12 V supplied to the COMM180 board is reduced and converted to −5 V through a 6.8-V Zener and an ICL7660 voltage-inverter IC (integrated circuit). The COMM180 expansion card has two audio jacks for audio in/audio out but also contains an LM386 amplifier chip that will drive an external speaker for call monitoring.

Addressing for the MOSART is predecoded on the SB180 board, and connections are made directly to the I/O-expansion-bus signals. Only a single 7423 is required to combine the various MOSART status outputs into a suitable interrupt to the microprocessor.

The COMM180 is built on a 4- by

4-inch board that mounts directly over the SB180 and plugs into the I/O expansion bus. Since the COMM180 is so simple and I had a lot of board space remaining, I decided to fill it up with yet another useful but presently undocumented expansion to the SB180. The COMM180 expansion board can optionally contain the necessary SCSI (small computer standard interface) hardware interface to attach a hard disk to the SB180 (see photos 2 and 3). The hardware is there, and the software should be finished by the time you read this. It will be the subject of a future Circuit Cellar article.

Z-System

The Z-System is an advanced single-user operating system compatible with programs intended to run under CP/M 2.2. It was discussed in detail in the October Circuit Cellar. The version supplied with the TKBBS differs slightly from the standard Z-System in that the ZCPR3 portion has been reconfigured as a "secure" system. The other significant difference is that an Input/Output Package (IOP) ZCPR3 system segment done especially for the TKBBS is included.

A secure configuration of ZCPR3 has some distinguishing characteristics. The major one is that the system no longer accepts what is known as the DU: form of changing the currently active disk drive and user area. This means that the caller cannot move from area to area in the system using commands like A0: and B3:. If a command of the DU: type is entered, it is simply ignored. Instead, the Named Directory functions of ZCPR3 are used for this purpose for system security. DU: references, if enabled, allow the user to enter any area of the system.

When configured so that named directories are the only way to change areas, the operator of the BBS can protect certain directories by defining them with passwords. Callers to the TKBBS will be able to freely enter areas that do not have passwords defined but will be unable to enter areas where a password is defined unless they know the password. In a public bulletin-board environment, security is mandatory. Files containing user names and passwords, for example, cannot be accessible to everyone.

In addition to the disabling of the DU: form, another characteristic of a secure ZCPR3 environment is the use of the wheel byte, again for system security. The wheel byte provides a convenient way of disabling dangerous commands that callers to the system should not be allowed to use. Examples of dangerous commands are erase a file (ERA), rename a file (REN), copy a file (CP), memory peek and poke (P and POKE), and SAVE. The convenient aspect of the wheel byte is that these commands can be activated if the wheel byte is set (nonzero). So, the sysop can make use of these commands by setting the wheel byte, yet when a caller is accessing the system, the TKBBS software will reset the wheel byte so that they cannot be used.

The special IOP system segment performs many important system functions in the TKBBS, like sensing if a caller disconnects and placing the local console in parallel with the modem so that the actions of the caller can be observed locally. Another important function of the TKBBS IOP is measuring the amount of time the current caller has been logged in. A caller exceeding the limit is disconnected.

Term III

Term III is similar in philosophy and structure to the ZCPR3 portion of the Z-System. This is not surprising because both Term III and ZCPR3 were written by Richard Conn. Term III is a collection of 23 programs that perform various communication functions, like file transfer or answering an incoming call. Term III uses many of the features of ZCPR3 in its operations and will run only with ZCPR3.

Like ZCPR3, Term III (T3 for short) works on a tools concept. The various programs and files are intended to be used together to create new programs and applications. The 23 programs are listed with a short description of each in the "Term III Programs" text box on page 100. It is important to note that T3 is a complete computer communications system intended to replace the functions of *all* the public-domain software mentioned previously. For this reason, the TKBBS software uses only certain programs from the 23 available. The ones not used by TKBBS are used in other applications, like on a caller's computer when calling a TKBBS. (However, there is no requirement that callers to a TKBBS use T3.)

Like ZCPR3, Term III works on a tools concept.

In operation, T3 relies heavily on the message buffers and two ZCPR3 programs, Alias and Menu. Alias is a ZCPR3 utility program that creates .COM files (executable programs) that contain operating-system-level commands. Using Alias, we can create an invokable program that carries out a sequence of commands in a fashion similar to the CP/M Submit and MS-DOS Batch functions. The user gives a name to the program created by Alias, and these programs are also known as aliases. The advantage of aliases over the CP/M or MS-DOS equivalents is that once the alias is invoked, it passes its embedded command string directly into the ZCPR3 multiple command line buffer, where it remains resident in RAM until the entire sequence of commands is executed. The CP/M and MS-DOS equivalents take their command strings, one command at a time, from a file. This difference means that an alias executes much faster than Submit or Batch since it does not access the disk drives to find the next command.

The Menu program is a ZCPR3 utility that processes menus. The Menu program reads a file, presents a screen to the user as defined in that file, and uses the remainder of the in-

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TERM III PROGRAMS

Following is a list of the programs provided with the Term III communications system. Programs marked with an asterisk are used as part of the TKBBS software. The other programs are not required for TKBBS operation.

COMMUNICATION

T3FILER: File transfer using XMODEM, MODEM7 Batch, Kermit, XON/XOFF, CIS (CompuServe), and Term protocols.

T3FLUSH: Used to gobble up unneeded characters from the modem.

T3SEND: Sends ASCII text via the modem port.

T3TERM: Emulates a terminal interfaced to the modem port, with extensive data-capture and -transmission options.

T3TERMB: Like T3TERM, but with some of the options stripped to allow for larger data buffers.

T3TEST: A simple test program to check communications with the modem.

TELEPHONE CONTROL

T3ANSWER: Monitors the modem and answers the telephone when a call comes in.

T3DIAL: Uses the dialing functions of the modem to initiate a call.

T3HANGUP*: Commands the modem to hang up the phone (go on hook).

T3INIT*: Initializes the modem to the desired speed and default conditions.

ACCESS CONTROL

T3LOGIN*: Establishes the system environment when the current caller logs on.

T3LOGCK*: Checks the LOGIN.TXT file used by T3LOGIN for proper syntax and reports statistics.

COMMAND-FILE PROCESSING

T3DO: A command-file processor that allows unattended operation of the Term III system.

T3VIEW: Records the user's interactions with a remote system. It is used in conjunction with T3MONRPT (described below) to create T3DO command files.

T3MONRPT: Analyzes the records made with T3VIEW to assist the user in creating T3DO command files.

COMMUNICATIONS SERVER

T3SERVER*: Allows a second computer system to be controlled by a computer running T3MASTER. All resources of the second computer (disk files, peripherals, etc.) are made available.

T3MASTER: Used as the controller of another computer executing T3SERVER. Can be suspended to run another program and then resumed with no effect on the corresponding T3SERVER.

EDITORS

EDCST: Communications set editor.

EDTMC: Keyboard macro editor.

EDTXD: Telephone directory editor.

EDXLT: Translation table (for transmitted and received data) editor.

MISCELLANEOUS

T3NOTE*: Logs system activity in the ACTIVITY.TXT file. It is used to track the caller's activities and comments.

T3INS: Similar to the ZCPR3 installation utility Z3INS. It is used to install the Term III programs if any major changes are made to the system.

formation in that file to process input by the user.

The ZCPR3 message buffers are a way for programs to exchange information. Physically, the message buffer is an 80-byte reserved area of RAM that contains various ZCPR3 entities known as registers, the ZCPR3 IF command status, and the ZCPR3 error flag. T3 uses the error flag and registers extensively. Listing 1 is an example showing the use of an alias and the error flag with the T3 software. Note the use of the ZCPR3 IF command, which determines if the T3ANSWER program terminated because a caller is present or because the sysop typed a Control-C locally.

THE T3ANSWER PROGRAM

T3ANSWER has the function in the TKBBS software of waiting until a caller is present. The COMM180's MOSART is repeatedly sampled by T3ANSWER until the MOSART indicates that it is receiving a ring signal from the telephone line. At this point, T3ANSWER sends a command to the MOSART to answer the call (go off hook) and emit what is known as answertone to the telephone line. Answertone is a high-pitched tone intended to indicate to the calling party that they have reached a modem. T3ANSWER then continues sampling the status of the MOSART until the MOSART indicates it is receiving a carrier tone from a calling modem. If no carrier tone is detected after 20 seconds, T3ANSWER commands the MOSART to hang up (go on hook) and returns to checking for the ring signal. If a carrier tone is received within the 20 seconds, T3ANSWER terminates and sets the ZCPR3 error flag to the false (zero) state.

A special enhancement to the TKBBS T3ANSWER makes use of the DTMF-decoding functions of the MOSART. During the 20-second time period that the MOSART is emitting answertone, if the DTMF digit "#" is received, T3ANSWER acts as though a carrier was received from a remote modem and terminates.

In addition to resetting the ZCPR3 error flag, T3ANSWER places the

value 01 into ZCPR3's register 4. Therefore, if you want to use the DTMF/voice response features of the MOSART, you can still use T3ANSWER and the TKBBS software for callers who have modems yet allow someone who does not have a modem to interact with the system. An example might be the sysop calling in from a pay telephone. Assuming he has written a program that lets him check the status of the TKBBS that takes its input as DTMF digits and outputs audio using the voice-synthesis capability of the MOSART, he can call, enter the "#" digit during the answertone period, and invoke the program. His program can then inform him of recent callers, read messages to him, or whatever else he may have programmed. A program to do something like this is not supplied with the TKBBS software, but this "escape code" or "hook" built into T3ANSWER allows a TKBBS to be much more than a bulletin board. (If anybody writes this program before I do, I'd like to see it.)

Z-MSG

Z-MSG is a message-handling system (see photo 4). As such, it is the electronic mail portion of the TKBBS. Z-MSG uses advanced programming techniques like program overlays and totals about 78K bytes of files, independent of the message storage and other accessories. The author of Z-MSG, Tim Gary, has optimized it for use with ZCPR3 and T3, transforming the TKBBS into a cohesive unit.

Originally written in C source code, Z-MSG is supplied as executable programs and overlay files. To allow the user a wide range of configuration flexibility, a program called ZMCONFIG is supplied. ZMCONFIG lets the user select whether the BBS is to be public or private, set the special sysop name and password, specify filenames and locations of files used by Z-MSG, set the maximum number of messages allowed and their length, edit the eight user types regarding their privileges, and much more.

Z-MSG features include large messages (up to 100 lines or more), the ability to change the options of the system without requiring recompilation, multiple categories of users (callers), extensive editing functions for messages being entered, and selective searching of available messages for those of interest. One nice feature of Z-MSG is that help for the user is available throughout the system just by entering a question mark.

Figure 2 illustrates a sample session with Z-MSG. It shows a caller logging onto Z-MSG. When somebody logs on, the message files are searched for any mail addressed to that caller. If a message is found, as shown, the caller is given the message number and the sender's name. Once the message is retrieved, Z-MSG asks the caller if a reply is to be made.

A powerful function of Z-MSG is its use of the ZCPR3 environment to allow execution of other programs (.COM files) from within the message system. This function's implementation lets the sysop add commands to

(continued)

Listing 1: *An alias called* TKBBS.COM *is used to put the turnkey bulletin-board system on line.*

Alias Contents	Comments (not part of the file)
1: T3INIT 2;	Initialize the modem
2: REG 4 0;	Flag T3ANSWER to not allow the DTMF "#" to be specially treated
3: T3ANSWER;	Execute T3ANSWER
4: IF ERROR;	If T3ANSWER did set the error flag . . .
5: ECHO LOCAL ABORT	The sysop aborted T3ANSWER locally
6: ELSE;	If T3ANSWER did not set the error flag . . .
7: DEV C CRTMODEM;	We have a caller, put console and modem in parallel (handled in the IOP), and . . .
8: Z-MSG X;	Execute Z-MSG
9: FI	Clean up IF status

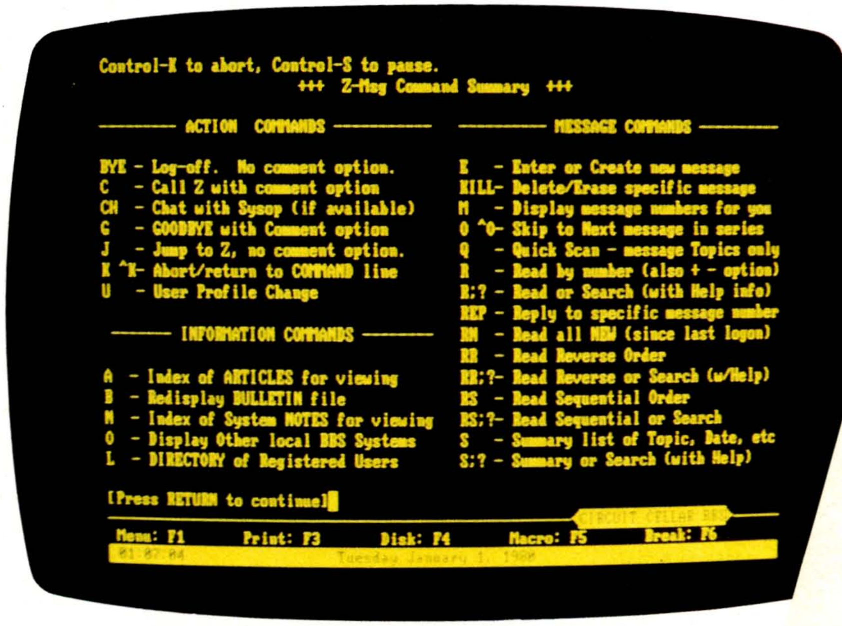


Photo 4: *A sample screen from the Circuit Cellar's* TKBBS, *showing a command summary of the Z-MSG message-handling program.*

What's your name (or SYSTEM ID)? *steve ciarcia*

[Checking for previous logon]
[...............]
Enter password? *1234*

[Updating logs]
Z-MSG Message-Handling System.
Version 1.30xx

You are caller 7996 (User #378).
You've called 2 time(s), last one being on 07/10/85.

There are 130 active messages. (26 are private)
Your last read message was 2540.
The current high message is 2541.

[Checking for your Mail]

[You have Mail!]

Number: From:
2541 David McCord [new] [private]

(Enter '?' for help) Command: *r*

Read message #(first = 1, Last = 2541)? *2541*

Msg #2541 posted 07/10/85 by David McCord
To: Steve Ciarcia <Priv> About: SB180 (4 lines)

Steve, I really like the SB180 I have. I especially like the built-in RAM disk.
A very nice design! By the way, what's the power consumption at 5 volts?
.....Dave

[Reply to this msg (y/n)?] [*yes*]

To: David McCord
Subject: SB180
[Is the subject ok (y/n)?] [*yes*]
(Private/Normal)? *p*

Enter message text following each line number.
To edit or end, hit RETURN alone on a line.
Up to 77 characters (letters/numbers) on a line
and 100 lines maximum.
1: *Dave, the power consumption of the SB180 is 500 mA at 5 volts and*
2: *40 mA at 12 volts. Thanks for the compliments.*
3: *Steve Ciarcia*
4:

(A)bort, (C)ontinue, (D)elete, (E)dit,
(I)nsert, (L)ist, (R)eplace, (S)ave,
(U)pload :: Select ? *s*

[Saving message #2542]

[Kill Message you've just replied to (y/n)?] [*yes*]

Msg #2541 posted 07/10/85 by David McCord
To: Steve Ciarcia <Priv> About: SB180 (4 lines)

Confirm (y/n)? [*yes*]

[Delete message #2541]

Figure 2: *A sample session with the electronic mail system* Z-MSG.

Z-MSG by editing a simple text file. No recompilation or reassembly is required, a unique feature for any program, be it message system or whatever.

TKBBS Security

As discussed previously, several files must be kept confidential in order to prevent compromising system security. The best way to keep them confidential is to store them in a disk drive/user area that has no directory name associated with it. Remember, the secure implementation of ZCPR3 accepts only directory names to change the active drive and user area. Therefore, if no name is defined for an area, it is impossible to enter that area. However, you may be asking yourself how the sysop can place files in these areas if they are impossible to enter. The answer is that the current set of directory names are changed easily by loading a different ZCPR3 Named Directory system segment into RAM. Thus, the sysop, when using the system locally, can operate with a set of directory names that includes names for the secure areas. When the system is being used by a caller, a different set of directory names is in effect, which does not include names for those areas. And the caller has no way of changing the active set of directory names.

The PATH function of ZCPR3 is also different depending on who is using the system. Typically, executable programs (.COM files) that callers can execute are stored on drive A, user area 0 (A0:). Examples of this kind of program are Z-MSG and T3HANGUP. So, the PATH for a caller is simply A0:, which means that the programs in A0: can be invoked from any other area of the system. However, sysops may have useful programs on the system that they do not want callers to be able to use. Examples of this kind of program are DU3 (disk utility) and the TKBBS.COM Alias discussed previously. For the sysop's convenience, the PATH can be set to A0: – >A15: when using the system locally. The PATH setting is independent of the named directories and can invoke programs

in unnamed drive/user areas, if necessary.

As another protection against compromise of system security, files received by the TKBBS in an uploading function are subject to being renamed because some caller may attempt to upload a .COM file in order to compromise system security. If this is attempted, the TKBBS software automatically renames it an .OBJ file to prevent it from executing. This protection can be overridden if the wheel byte is set.

CIRCUIT CELLAR BBS

As mentioned earlier, I have set up a Circuit Cellar private-access BBS that uses the configuration outlined in this article. It can be reached 24 hours a day at (203) 871-1988. I intend to use it to supplement projects by providing part lists, program listings, project updates, and other useful information. I invite you to join.

For the month of December, you can call and see a demonstration of the TKBBS and register for continued access. On January 15, 1986, subsequent access will be limited to those who have registered and received an ID by mail. To become a member after that date, send me a postcard or letter with your return address, and I will send you an ID and password for the system. You will retain access as long as the following code of ethics is maintained:

1. No distribution of copyrighted software or encouragement thereof.
2. No distribution of private access codes, credit card codes, or engaging in any other unlawful activities.
3. No obscene or offensive language permitted in open areas.
4. No X-rated activities or messages permitted in open areas.
5. Any user guilty of violating any of the published rules will be denied access.
6. Any attempt to tamper with the board, alter the system, or gain sysop access will result in deletion.
7. No use of abusive language or conduct toward any other user in open areas.
8. Users will follow all posted system regulations. A warning note will be given to a user if they have done something that is not publicly posted but is against the wishes of the sysop.
9. This board is not funded by BYTE and is my private property. I have the right to deny the use of this system to anyone for any reason I deem fit.

These rules are not intended to be restrictive. They are intended to make this system a pleasure to use by all responsible parties and prevent the abuses that have brought legal action against BBS sysops and users alike. Circuit Cellar readers are of all ages and both sexes, and I am concerned for their welfare. If we cannot control the activities of our own boards, numerous federal and state agencies will happily do it for us, and the last thing we need is government controls.

CONCLUSION

The SB180 TKBBS hardware and software is an extremely powerful package that makes the most of the capabilities of the Xecom 1203 MOSART and the Z-System operating system of the SB180.

Perhaps the only significant limitation of the TKBBS lies in the amount of storage available as dictated by the current BIOS (basic input/output system). Although the system could be expanded to about 3.1 megabytes of storage by using four 96-tpi (tracks per inch) floppy-disk drives, it is not unusual for a public bulletin board to make use of hard disks in the 5- to 40-megabyte range. A tremendous amount of public-domain and freeware-type software is available, which necessitates a large amount of storage capacity if your bulletin board is to carry a wide selection. Of course, this limitation will disappear when the hard-disk interface on the COMM180 board is operational.

CIRCUIT CELLAR FEEDBACK

This month's feedback is on page 420.

NEXT MONTH

A multichannel 12-bit A/D converter for the BCC52. ■

Special thanks to Dave McCord, Rick Conn, and Tim Gary for their contributions to the TKBBS.

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The SCSI hard-disk-interface section is designated as the COMM180-S. It has a 50-pin SCSI bus header and is Zebec 1410/Adaptec ACB4000 controller–compatible. It comes with a BIOS upgrade on disk.

The printed-circuit board for either version is completely socketed and can be upgraded to include both functions at any time. The combination modem/SCSI interface board is designated as the COMM180-M-S. Software is supplied on 5¼-inch double-sided double-density SB180 format disks with manuals. Boards are available assembled and tested only.

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Editor's Note: Steve often refers to previous Circuit Cellar articles. Most of these past articles are available in book form from BYTE Books, McGraw-Hill Book Company, POB 400, Hightstown, NJ 08250.

Ciarcia's Circuit Cellar, Volume I covers articles in BYTE from September 1977 through November 1978. *Volume* II covers December 1978 through June 1980. *Volume* III covers July 1980 through December 1981. *Volume* IV covers January 1982 through June 1983.

To receive a complete list of Ciarcia's Circuit Cellar project kits, circle 100 on the reader-service inquiry card at the back of the magazine.

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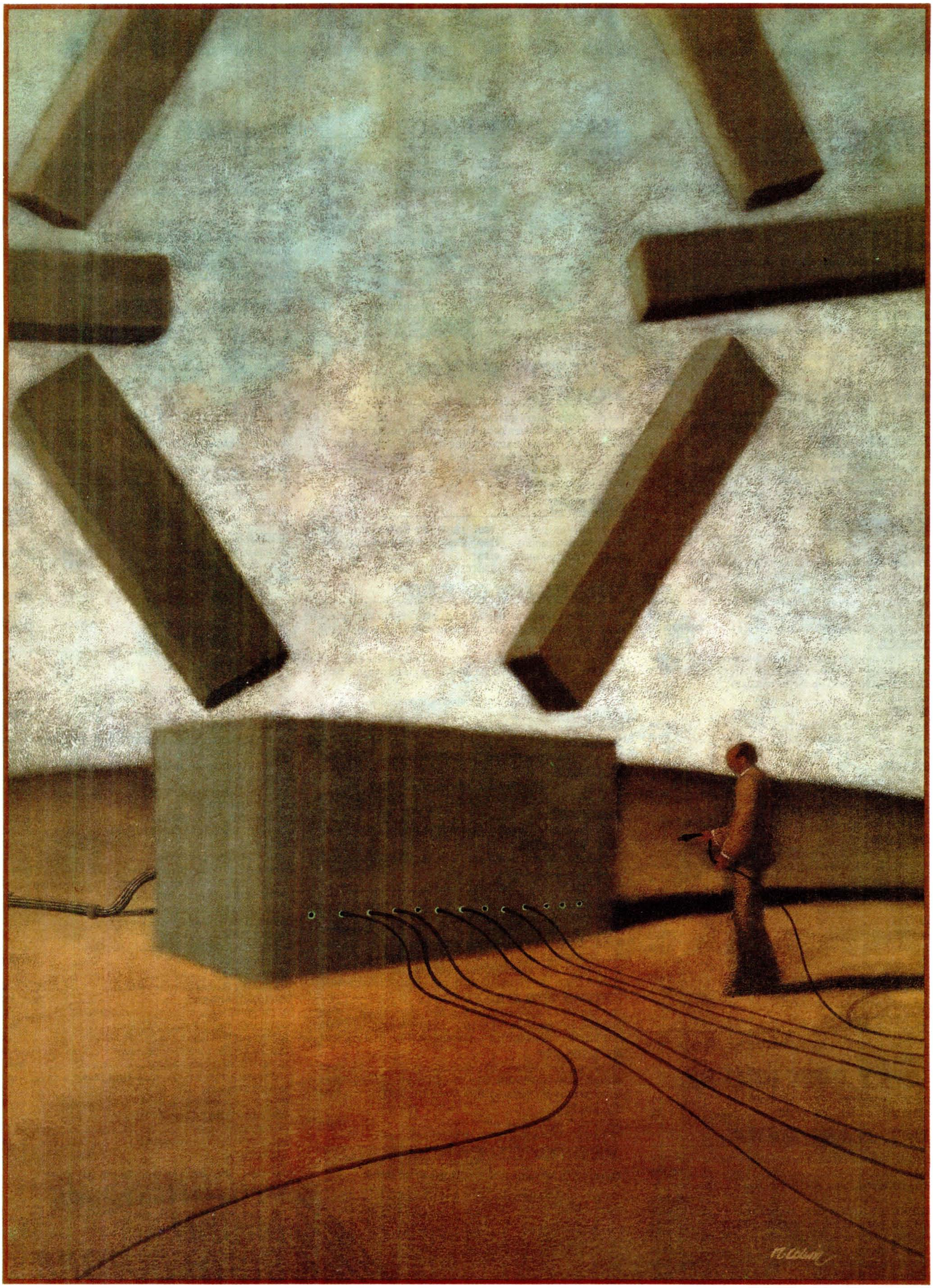
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A SIMPL COMPILER PART 1: THE BASICS

BY JONATHAN AMSTERDAM

An implementation of a compiler for a simple structured language

In this article—the first of a three-part series on the construction of a compiler for a high-level language—I will discuss the basics of the compiler. Next month I will talk about procedures and functions, and in the third part of the series I will describe some of the compiler's extensions.

Three of my earlier Programming Projects are prerequisites for this one. "Context-Free Parsing of Arithmetic Expressions" (August, page 138) explains the parsing technique I will be using. "Building a Computer in Software" (October, page 112) describes VM2, the virtual machine for which my compiler is targeted. And "A VM2 Assembler" (November, page 112) details the assembly-language code that the compiler will generate.

THE SIMPL PROGRAMMING LANGUAGE

I will be describing a compiler for a language of my own design, called SIMPL. SIMPL, which stands for "SIMPL Isn't Much of a Programming Language," isn't much of a programming language. SIMPL's grammar is given in figure 1. There are a few points that are not described by the grammar. An identifier is any string of letters and numbers beginning with a letter. Unlike most implementations of Pascal, SIMPL is case-sensitive, so the identifiers READ and Read mean different things. SIMPL keywords, like PROGRAM and BEGIN, are capitalized. Comments in SIMPL are delimited by braces ({ }). As in Pascal, character constants are delimited by single quotes, but SIMPL also allows the backslash character (\ ) to act as an escape. When followed by an n or a t, the backslash denotes a new line (carriage return) or tab; when followed by any other character, it denotes that character. For example, the character constant for the single quote looks like ' \ '.

SIMPL's WHILE and IF statements, like those of Modula-2, are explicitly terminated by an END. The AND operator has the same precedence as OR, and both have weaker precedences than those of all other operators, so it is unnecessary to put parentheses around expressions connected by AND and OR. Furthermore, expressions surrounding an AND or OR will be evaluated from left to right, and no more than necessary will be evaluated. For example, in the expression TRUE AND FALSE AND TRUE, the first TRUE will be evaluated and then the FALSE will be

(continued)

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evaluated; at that point, evaluation of the second TRUE will be skipped because the value of the whole expression must be FALSE.

SIMPL has procedures and functions much like those of Pascal, but rather than assigning a value to the name of the function, a value is returned from a SIMPL function using the RETURN statement. A RETURN without an expression can be used to exit from a procedure. It cannot be used in the main program.

SIMPL has two built-in procedures, READ and WRITE. These procedures can only read or write integers or characters and only from the keyboard or screen. Both take any number of arguments. The arguments to READ must be variables; those to WRITE can be any expression.

SIMPL supports variables of types INTEGER, BOOLEAN, and CHAR. It has five kinds of statements: WHILE, IF, RETURN, assignment, and procedure call. SIMPL has no FOR loops, strings, case statements, arrays, constants, reals, type declarations, records, sets, repeat loops, GOTOs, labels, files, scalar types, VAR parameters, pointers, or math functions. Indeed, SIMPL lives up to its name.

Still, even for this language, writing a compiler is not easy. The compiler consists of 12 modules and is over 3000 lines long. The source code, written in Modula-2, is available on BYTEnet Listings at (617) 861-9764.

WHAT IS A COMPILER?

A compiler is a program that translates other programs from one form to another. The compiler's input is a source file, which is a sequence of characters that constitutes the human-readable text of the program. Some compilers translate this directly into object code, which can be loaded and executed by the machine. Other compilers produce as output another text file containing an assembly-language version of the program. This text file must then be translated into object code by an assembler. Although going directly from source code to object code saves a step in the translation process, my compiler takes the second approach for two reasons. First, producing an assembly-language version of the program makes it easier to write the compiler because I don't have to worry about bookkeeping details (like forward references of labels) that the assembler can handle. Second, I can examine and change the human-readable assembly-language file. This can be useful for debugging the compiler and hand-optimizing its output.

Readers of "A VM2 Assembler" will recall that an assembler is also a program translator. But whereas assembly is relatively easy, compilation is considerably more difficult. There are two reasons for this, the first of which is fairly clear: Assembly-language programs correspond line for line with the object code that has to be generated, but high-level-language programs, by definition, do not. A standard computer instruction set does not provide WHILE loops, IF. . . THEN . . . ELSE statements, evaluation of arithmetic expressions, etc. Furthermore, at the machine level a variable is simply a memory location, but a high-level-language variable is something else. For one thing, it has a particular type associated with it, as well as a scope, or range of visibility (a topic I'll be discussing at length in part 2 of this series). If you compare the program in listing 1 with the one in listing 2, you'll get a sense of how different high-level language and assembly language are from each other.

Compilation is difficult for another reason as well: Users of high-level languages would like the object code produced by the compiler to be just as short and run just as fast as hand-coded assembly-language programs. So compiler writers strive to improve the compiler's generated code. For example, it is a good idea to keep frequently used values in the registers of the computer because they can be accessed faster than memory locations; therefore, compiler writers have developed algorithms for optimizing register usage. Also, most computers have "special case" instructions that can speed up certain common operations (such as incrementing a number), and a good compiler will use these instructions where appropriate.

While writing my compiler, I did have to deal with translating high-level SIMPL statements into low-level VM2 instructions, but I could avoid some

```
program ::= PROGRAM id; vars routines block .

vars ::= empty | VAR varlist
varlist ::= decl | decl varlist
decl ::= idlist : type ;
idlist ::= id | id , idlist
type ::= INTEGER | BOOLEAN | CHAR

block ::= BEGIN stmts END
stmts ::= empty | stmt ; stmts
stmt ::= while | if | return | assign | call
while ::= WHILE expr DO stmts END
if ::= IF elsif END
elsif ::= expr THEN stmts else
else ::= empty | ELSIF elsif | ELSE stmts
assign ::= id := expr
exprlist ::= expr | expr , exprlist

expr::= expr | relexpr | relexpr OR expr | relexpr AND expr
relexpr ::= intexpr | intexpr relation intexpr
intexpr ::= term | term + intexpr | term—intexpr
term ::= factor | factor * term | factor / term
factor ::= id | number | funcall | char |—factor | NOT factor | ( expr )
relation ::= > | < | = | <> | >= | <=
```

Figure 1: *The SIMPL grammar used by the parser.*

Listing 1: *A program written in* SIMPL *that calculates the greatest common divisor of two integers, using* Euclid's *algorithm.*

```
PROGRAM Euclid;
VAR m, n,temp, r:INTEGER;
BEGIN
    WRITE('?');              { Prompt user for two integers }
    READ(n);
    WRITE('?');
    READ(m);
    IF n < m THEN            { Make sure n is the larger of the two }
        temp := n;
        n := m;
        m := temp;
    END;
    r := n - m*(n/m);        { r := n MOD m }
    WHILE r > 0 DO
        n := m;
        m := r;
        r := n - m*(n/m);    { r := n MOD m }
    END;
    WRITE(m);                { m is the GCD—output it }
END.
```

Listing 2: VM2 *assembly-language code produced by the* SIMPL *compiler upon compilation of the program in listing* 1.

```
      BRANCH Euclid
m:    0
n:    0
temp: 0
r:    0
Euclid:
      PUSHC    '?
      WRCHAR
      RDINT
      POPC     n
      PUSHC    '?
      WRCHAR
      RDINT
      POPC     m
      PUSH     n
      PUSH     m
      LESS
      BREQL    L1
      PUSH     n
      POPC     temp
      PUSH     m
      POPC     n
      PUSH     temp
      POPC     m
L1:
      PUSH     n
      PUSH     m
      PUSH     n
      PUSH     m
      DIV
      MUL
      SUB
      POPC     r
L2:
      PUSH     r
      PUSHC    0
      GREATER
      BREQL    L3
      PUSH     m
      POPC     n
      PUSH     r
      POPC     m
      PUSH     n
      PUSH     m
      PUSH     n
      PUSH     m
      DIV
      MUL
      SUB
      POPC     r
      BRANCH   L2
L3:
      PUSH     m
      WRINT
      HALT
```

of the complexities of generating good code because I was compiling for VM2, a machine I designed to make it easy to compile high-level languages. For example, I didn't have to worry about register allocation because VM2 doesn't have any registers (except for some special-purpose ones with which the compiler needn't be concerned). This simplification was behind my decision to make VM2 a stack machine. Also, VM2's instruction set is simple and provides no special-case instructions, so I don't have to worry about using them.

A compiler's job can be divided into at least four phases: lexical analysis, parsing, type checking, and code generation.

Lexical Analysis

The compiler's first task is to translate the stream of characters that constitute the input into a more agreeable form. The lexical analyzer transforms the character stream into a stream of tokens, or lexical items that are meaningful to the compiler.

What counts as meaningful depends on the program, of course. My lexical analyzer for SIMPL has many different types (or classes) of tokens, including IDENTIFIER for variables, INT for integers, and a different class for each keyword. For example, the lexical analyzer will consume from the input the five characters W, H, I, L, and E, when they occur consecutively and are delimited on both sides by white space (spaces, tabs, or carriage returns), and will then return a token of class WHILE. If the lexical analyzer sees the characters 3, 4, and 5 occurring consecutively, it will convert them into an integer, 345, and return a token of class INT, which also contains the number 345.

The lexical analyzer's design is similar to that of the VM2 assembler's lexical analyzer. Where the lexical analyzer of the assembler allowed you to "unget" the last character that was taken from the input, the SIMPL lexical analyzer allows you to unget a token—that is, to arrange matters so that the next call to the lexical analyzer will return the same token.

Parsing

SIMPL programs are more than just lists of tokens. They have a complex structure, as reflected by the grammar shown in figure 1. A WHILE loop, for example, consists of a Boolean test and a group of statements; an assignment statement has a variable on the

(continued)

left side and an expression on the right; and so on. It is the parser's job to impose structure on the token stream. In my compiler, the parser will actually construct a parse tree—a data structure that reflects the structure of the program. A typical parse tree is shown in figure 2.

Readers of "Context-Free Parsing of Arithmetic Expressions" will recall that I built a parse tree from an expression by writing a procedure for each rule of the grammar and by having the procedure consume just as much of the input as was necessary to parse its particular rule. I'll use the same technique, called top-down or recursive-descent parsing, for my compiler.

TYPE CHECKING

Every variable and function in SIMPL has a particular type—integer, character, or Boolean—and the use of these types is governed by several rules. For example, you can only add integers, you can only compare two expressions of the same type for equality, and the types of the arguments to a procedure and the procedure's formal parameters must be identical. Pascal programmers should be familiar with these rules. The compiler enforces them by checking each expression as it is parsed to make sure it conforms. Since variables, procedures, and functions must be declared before they are used, the compiler always knows the types of the variables involved in the expressions.

CODE GENERATION

In the fourth phase of compilation, the compiler translates the parse tree into the actual assembly-language code. As I mentioned, this process can be very involved, but for my compiler it is fairly straightforward.

Some compilers have additional phases. Often, an optimization phase occurs either just before or just after code generation. In this phase, transformations are made to either the parse tree or the assembly-language code to make the generated code more efficient.

INTERMEDIATE REPRESENTATION

As I've described it, the SIMPL compiler constructs a parse tree from the input and then generates code from the tree. Why not skip the parse tree altogether and have the parser call the code generator directly? This is certainly possible and has the advantage of speed—constructing the parse tree takes some time. But I think it's a good idea to have some sort of intermediate representation (IR) like a parse tree for a couple of reasons.

First, it allows you to separate the "front end" of the compiler—the lexical analyzer, parser, and type checker—from the "back end"—the code generator. The IR serves as a common language that lets the two ends communicate. For instance, if your compiler is too big to fit into memory all at once, you can first generate the IR, then swap in the back end to generate the code. Such multipass compilers are common, but mine will only make a single pass over the input.

An IR also makes it easy to mix and match compiler parts, which means you can use the same code generator for Pascal and C or the same front end for a compiler that generates VM2 code and for one that produces Motorola 68000 code. Or, instead of generating code from the IR, you can write an interpreter for it. In short, an IR helps make your compiler more modular, and modularity is the essence of good software engineering.

There's another important reason for using an IR: It provides a more abstract view of the program being compiled. The source code and object code are just lists of characters or numbers, but the IR can represent the program in a way that more clearly reveals its structure to the compiler. For instance, if the compiler wants to know what statements are part of the WHILE loop in listing 1, it can much more easily determine that information from the parse tree in figure 2 than from the source code in listing 1. A compiler may want to use this information for optimizing the code. The IR can aid code generation by making certain aspects of the code explicit. For a stack machine like VM2, the parse tree is a natural choice.

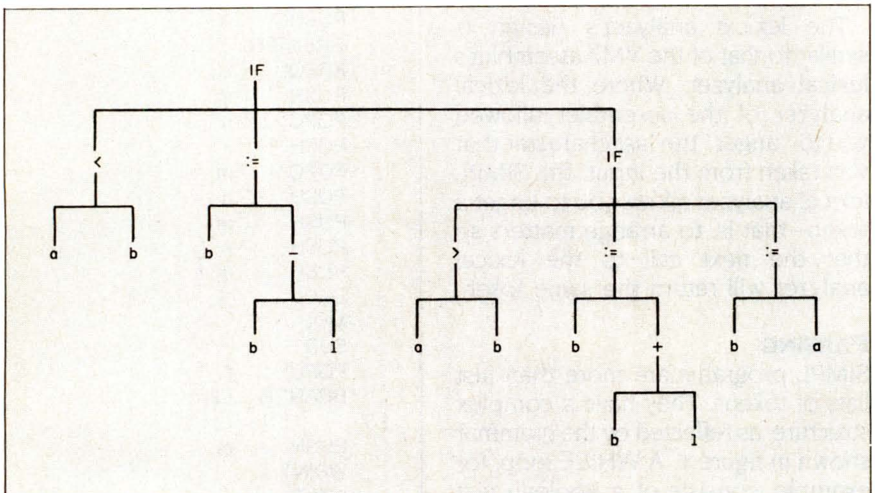


Figure 2: *Parse tree for the* SIMPL *statement* IF a < b THEN b := b − 1; ELSIF a > b THEN b:= b + 1; ELSE b := a.

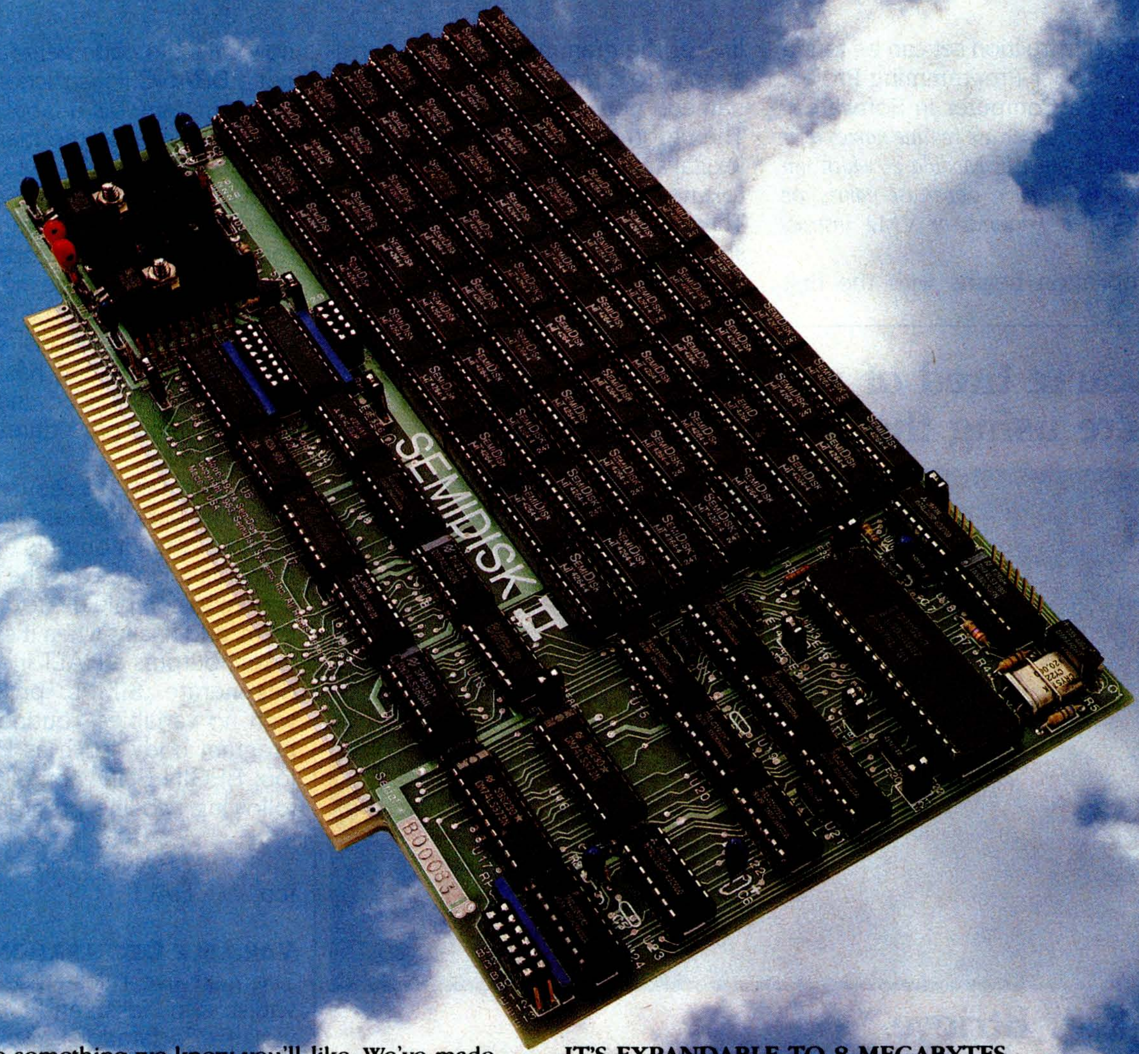
THE COMPILER IN DETAIL

I described the various phases of compilation as if they occurred one after the other in a simple procession. In fact, they overlap in a complex dance choreographed by the parser. In the text that follows I'll explore the compiler in greater detail, using the grammar of SIMPL as my guide. I will be referring to specific VM2 instruc-

(continued)

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tions (the instruction set can be found in my October Programming Project "Building a Computer in Software"). [*Editor's note: Lowercase routine names refer to routines written in Modula-2, which implement the compiler; uppercase names are either* SIMPL *keywords or* VM2 *instructions.*]

Compilation begins with the first line of the grammar. This line corresponds to a procedure in the parser named, not surprisingly, program. The program procedure first calls the lexical analyzer to make sure the first token is the keyword PROGRAM. Then it gets another token, which should be an identifier. This token is the name of the program. The parser now calls the code generator to output a BRANCH instruction using the program name as a label. This must be done because the main program code is not compiled until after the routines and global variables are compiled; you have to jump over the routine and variable code to get to the main program. The main program occurs at the end of the file because the SIMPL compiler is a one-pass compiler—everything has to be defined before it's used, including the main program's procedures, functions, and variables.

The program procedure then calls two other parser procedures, vars and routines. Then it outputs the program name as a label, calls the block procedure to compile the text of the program, and finally, when it sees the dot token, outputs a HALT instruction. A degenerate SIMPL program—one with no variables, routines, or main program body—such as PROGRAM foo; BEGIN END. compiles into the following two-line program:

```
        BRANCH foo
foo:    HALT
```

VARIABLE DECLARATIONS

The next five rules—those for vars, varlist, decl, idlist, and type—handle variable declarations. You'll note that the vars rule can be empty; that is, the program might not have any variable declarations. The parser can easily recognize this simply by checking whether the next token is VAR:. If so, the varlist procedure is called; if not, the parser calls the lexical analyzer's ungetToken routine to return the token to the input for future consumption.

The varlist procedure calls the decl procedure, then examines the next token to see if it is a BEGIN, PROCEDURE, or FUNCTION. If it's any of these three, then there are no more variable declarations; if it isn't, then there are more declarations, and varlist calls decl again. In either case, the token is ungotten.

A declaration consists of a list of identifiers—the variable names—followed by a colon and then by a

type name. The decl procedure begins by calling idlist, which returns the identifiers in a linked list. Then decl reads the type name and calls the code generator to generate code for the variables. Then, a label—the variable's name—has to be generated, followed by some initial value for the variable. I use 0 as an initial value, which is interpreted as FALSE for Boolean variables and as the ASCII NUL character for character variables.

However, the compiler must do more than merely generate code. It also has to store information about these variables for use later in the compilation. The type of a variable is needed for type checking, and the fact that a variable is global will affect how the code generator produces references to it. My compiler puts all this information into a record called a symbol and inserts it into its symbol table. The symbol table is a close relative of the label table used in the VM2 assembler—it has a similar purpose and is also best implemented as a hash table. The compiler's symbol table is rather more complex, though, because it also has to handle local variables. I'll defer discussion of its complexities to the second part of this series.

STATEMENTS

The bulk of the compiler is involved in translating SIMPL statements. Statements occur in lists, as the stmts line in figure 1 indicates. A list of statements can be empty. How does the stmts procedure recognize this? If you examine the grammar closely, you'll notice that any statement list is ended by one of the three keywords ELSE, ELSIF, or END, so these can be used to tell when a statement list is empty.

Let's examine each of the SIMPL statements in turn. I will defer treatment of the procedure call and RETURN statements to part 2 of this series. Figure 3 illustrates the code generated for each type of statement.

ASSIGNMENT STATEMENTS

To parse an assignment statement, the parser first calls the lexical analyzer to get the identifier on the left side of the statement. The parser can't distinguish an assignment statement from a procedure call until it calls the lexical analyzer to read the next token. If the next token is a :=, the parser knows this is an assignment statement. Then the parser checks to see if the identifier has been defined by looking it up in the symbol table. It also checks to make sure the identifier is the name of a variable, not a procedure or function. The parser then calls the expr routine to parse the expression and subsequently calls a special tree-building procedure to construct the parse tree from the variable and the expression. Parse trees consist of several different types of nodes. The tree-building procedure for the assignment statement creates a symbol node for the variable, an expression node for the expression, and makes both these nodes the children of an assignment node. It also checks the types of the variable and the expression to make sure they match.

To generate the code for an assignment statement, the code generator first generates code for the expression. At run time, after this code is executed, the result of the expression will be on the top of the stack. To store it in the variable, the compiler needs only to generate a POPC instruction with the variable's name as an argument (see figure 3a).

THE WHILE STATEMENT

The parser's while procedure reads the expression following the WHILE token and checks to make sure its type is BOOLEAN. It then reads the DO followed by a list of statements. A tree-building procedure creates a WHILE node and makes the Boolean expression and the statement list its children.

To generate code for a WHILE statement, the compiler first creates two new labels; let's call them START and END for now, although in the actual code generator there is a special function that generates a unique label

(continued)

```
(a)  var := expr                 | (code for expr)
                                 | POPC var
---------------------------------------------------------------
(b)  WHILE expr DO               | START:  (code for expr)
         stmts;                  | BREQL END
     END;                        | (code for stmts)
                                 | BRANCH START
                                 | END:
---------------------------------------------------------------
(c)  IF expr THEN                | (code for expr)
         stmts                   | BREQL END
     END;                        | (code for stmts)
                                 | END:
---------------------------------------------------------------
(d)  IF expr THEN                | (code for expr)
         stmts1                  | BREQL ELSE
     ELSE                        | (code for stmts1)
         stmts2                  | BRANCH END
       END;                      | ELSE:  (code for stmts2)
                                 | END:
---------------------------------------------------------------
(e)  WRITE(intexpr,charexpr);    | (code for intexpr)
                                 | WRINT
                                 | (code for charexpr)
                                 | WRCHAR
---------------------------------------------------------------
(f)  READ(intvar, charvar);      | RDINT
                                 | POPC intvar
                                 | RDCHAR
                                 | POPC charvar
```

Figure 3: VM2 *code generated for* SIMPL *statements.*

name each time it is called in order to avoid name conflicts. The code generator begins by outputting the START label and then generates code for the Boolean expression. If this expression evaluates to FALSE, the loop shouldn't be executed, so the instruction BREQL END is output; this will have the effect of branching to the END label if the expression evaluates to FALSE. Now the body of the loop is generated, followed by a BRANCH START instruction to repeat the loop. Finally, the code generator outputs the END label (see figure 3b).

THE IF STATEMENT

The IF statement is a bit tricky to parse because it may contain ELSIFs and an ELSE. I have divided the work among three procedures, if, elsif, and else. You can tell when an ELSE is empty by seeing if the next token is END.

As with the WHILE statement, I check to make sure that I have parsed a Boolean expression. When I am done parsing, I build a tree whose root is an IF node and whose three children are the Boolean test, the THEN part, and the ELSE part. Note that the ELSE part may itself be another IF statement; this is what happens when ELSIF is used (see figure 1). If there is no ELSE part, I fill the ELSE slot of the IF node with the value NIL.

To generate code for an IF with no ELSE part, I create a single new label: END. I generate code for the Boolean expression and then output a BREQL END instruction, because I want to skip the THEN part if the expression is false. Then I generate the THEN part and finally output the END label (see figure 3c).

When an IF has an ELSE part, I create two new labels—ELSE and END. Again, I first generate the Boolean expression. Now, if this expression is false I want to branch to the ELSE part, so I generate a BREQL ELSE instruction. Then I generate the THEN part of the code, but I follow it by a BRANCH END instruction so control doesn't fall through to the ELSE code. I then output the ELSE label followed by the code for the ELSE part. Finally, I output the END label (see figure 3d).

THE READ AND WRITE STATEMENTS

The parsing of READ and WRITE statements is similar; in both cases, I read a list of expressions and attach this list to either a READ or a WRITE node, as the case may be. I also check each argument to make sure it is of type INTEGER or CHAR. For a READ statement I check to make sure the argument is a variable.

To generate code for a WRITE statement, I generate the code for each expression, immediately followed by either a WRINT or a WRCHAR instruction, depending on the type of the expression. For each variable in a READ statement, I first generate either a RDINT or a RDCHAR instruction, then a POPC with the name of the variable (see figures 3e and 3f).

EXPRESSIONS

The parser used for expressions is similar to the one I described in "Context-Free Parsing of Arithmetic Expressions." It has been expanded to handle variables, function calls, and Boolean operators, and it has been made left-associative so that it parses arithmetic operators in this way: a + b + c will be parsed as (a + b) + c rather than as a + (b + c).

The compiler type checks expressions as their trees are constructed. Before constructing the tree for a + b, for example, the compiler makes sure that a and b have been defined as variables of type INTEGER. The Boolean operators AND, OR, and NOT require Boolean operands. For relational operators like = and >, it doesn't matter what type the two operands are, so long as they are of the same type.

Because of the way I designed VM2's instruction set, generating code for expressions is easy. I first generate the code to place the operands on the stack using the instructions PUSH (for variables) or PUSHC (for constants), then I output the instruction corresponding to the operator. All operators but AND and OR have a corresponding instruction. See figure 4a for the code generated by an expression.

The operators AND and OR are special cases because the second argument shouldn't be evaluated unless absolutely necessary. I treat them much like IF statements. For AND, I first create two new labels, which I'll call FALSE and END. I generate the code for the first argument, then generate a BREQL FALSE

(a) 1 + x = 5 − y*z

```
        PUSHC   1
        PUSH    x
        ADD
        PUSHC   5
        PUSH    y
        PUSH    z
        MUL
        SUB
        EQUAL
```

(b) a = b AND c <> d

```
        PUSH    a
        PUSH    b
        EQUAL
        BREQL   FALSE
        PUSH    c
        PUSH    d
        NOTE    Q
        BRANCH  END
FALSE:  PUSHC   0
        END:
```

Figure 4: VM2 *code generated for* SIMPL *expressions.*

instruction. After that I generate the code for the second argument and then a BRANCH END. Then I output the label FALSE, followed by a PUSHC 0 instruction. Finally, I output the END label. This code will have the following effect at run time: If the first argument evaluates to FALSE, then a FALSE (that is, a 0) is pushed on the stack and the code for the second argument is skipped. If the first argument comes out TRUE, then the second argument is evaluated, and its result is the result of the entire AND. Things are reversed for OR. If the first argument is TRUE, I push TRUE and skip the second argument; otherwise, the result of the second argument is the result of the entire OR. The code generated for an AND statement is in figure 4b.

ERROR HANDLING

It is notoriously difficult to write a compiler that can recover gracefully from an error in the source program and continue compiling. On the other hand, you wouldn't want to make the compiler too lenient when it encounters an error—a friend of mine speaks of how he used to feed interoffice memos to a COBOL compiler to see if they would compile successfully. They often did.

One solution to the error-handling problem is to stop the compiler after the first error is found, but this is a cop-out. I'd like the compiler to find as many errors as it can so I can try to fix them all at once. At the same time, I want to avoid cascades of errors, where the first error triggers new ones that wouldn't have appeared if the first error had not occurred. A compiler that frequently produces error cascades is just as bad as one that dies after the first error because you will trust the compiler only for the first error anyway. Error cascades are particularly common for syntax errors because it's hard to know where to continue parsing when something unexpected appears.

My compiler is far from ideal at handling syntax errors, but it deals with other errors reasonably well. The basic rule I use in parsing is, if an expected token does not appear in the input, pretend it did appear and continue on without it. For example, if the keyword PROGRAM does not appear at the beginning of the program, the compiler prints out an error message and acts as if it did appear. Similarly, if the program name is omitted, the compiler prints an error message, makes up a dummy name, and continues. Sometimes such errors are not handled so gracefully. If you meant to write WHILE a > b DO ... and instead omitted the WHILE keyword, the parser would read the identifier a and begin compiling the statement as if it were a call or assignment. The resulting error cascade isn't pretty.

A common source of error cascades is an undeclared variable. Some compilers will tell you over and over again that a variable is undeclared, outputting a message every time the variable is encountered. A much better solution is to print the message once and then ignore that variable from then on. I do this by inserting the variable in the symbol table once it has been seen. But what type should it be given? If I decide to make it an integer when in fact the programmer intended it to be a Boolean, I will find myself with a bunch of unnecessary type errors.

My solution is to give undeclared variables the special type Unknown. Unknown is compatible with every other type, so the type-checking routines will never find a problem with a variable of type Unknown.

IMPLEMENTATION NOTES

The key to writing a program as large as a compiler is breaking it up into small, independent parts. As I said before, my program is divided into 12 modules.

The main module is called Compiler. It is short and does little more than read an input filename and call the parser. Because of its size, the parser is divided into three separate modules: Parser handles the bulk of SIMPL, ExprParser takes care of expressions, and Routines is concerned with procedures and functions.

A common source of error cascades is an undeclared variable.

The LexAn module contains the lexical analyzer. The Token module defines the token data structure as well as some other useful types and constants. TypeChecker handles type checking, of course. Equally obvious is the function of SymbolTable. The Symbol module defines the data structure used for storing identifiers in the symbol table, and the Node module defines the data structure used to construct parse trees. Node also contains the important tree-building procedures.

Two other modules constitute the compiler's back end. CodeGen takes parse trees and calls procedures in CodeWrite to actually output the VM2 instructions.

My motivation for dividing the work up as I did was to distribute the load evenly. The code generator's time is split between the abstract work of generating code from parse trees, handled by CodeGen, and the nitty-gritty details of outputting VM2 assembly-language instructions, handled by CodeWrite. The parser definitely has the hardest job in this compiler, so I tried to make its tasks as simple as I could. The lexical analyzer looks up keywords in the symbol table and provides several routines that handle the work of generating syntax errors, thus relieving the parser of those burdens. The tree-building routines of the Node module not only construct trees but do much of the type checking as well. The code generator need only be given the parse tree to generate code.

CONCLUSION

As it stands now, the compiler is incomplete. The implementation of procedures and functions remains to be done, but the framework is in place. At heart, all compilers resemble the program described here. ■

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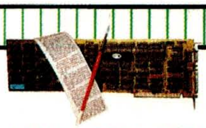
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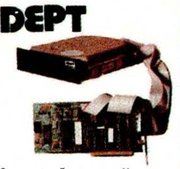
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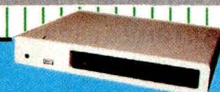


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THE TANDY 600 AND THE TANDY 3000

A *laptop computer with disk storage and an* IBM PC AT *clone*

Editor's note: The following is a BYTE *product description. It is not a review. We provide an advance look at these new products because we feel they are significant. This description is based on a look at a production version of the Tandy 600 and at a prototype Tandy 3000.*

A new Tandy Corporation laptop computer and an IBM PC AT clone debuted this fall (see photo 1). Announced on October 28th, the Japanese-made Tandy 600 is an 80C88-based laptop machine with a maximum RAM (random-access read/write memory) potential of 224K bytes and a built-in 360K-byte 3½-inch disk drive. A 9½-pound machine with a flip-up 80-character by 16-line LCD (liquid-crystal display), the Tandy 600 costs $1599. Unveiled at COMDEX in Las Vegas, the Tandy 3000, a clone of IBM's PC AT, carries a price tag as low as $2599.

THE TANDY 600

Product designers at Tandy describe the Tandy 600 as a machine with the features that users of the Model 100 and the Tandy 200 most often requested: an 80-column screen, a disk drive, and more RAM. Tandy also availed itself of the opportunity to upgrade its previous portable computer software in this addition to its laptop computer line.

To address more RAM without complicated bank-switching hardware and software, Tandy chose to power the 600 with a CMOS (complementary metal-oxide semiconductor) version of the Intel 8088 microprocessor running at 3.07 MHz. Standard RAM is a paltry 32K bytes, but 96K-byte RAM upgrade kits are available for $399.95 per kit, plus installation by Tandy. The Tandy 600 can accommodate up to 224K bytes of RAM. Thus, a Tandy 600 with maximum RAM will cost a tidy $2398.90 plus memory installation costs.

The 80-column by 16-line LCD is adjustable for lighting conditions and has a matte finish to reduce glare. The 9- by 2½-inch LCD flips up to reveal a keyboard similar to the Tandy 200's. This 72-key, typewriter-style keyboard offers 10 function keys, 4 cursor-control keys, a Label key, and a Num Lock key to turn letter keys on the right side of the keyboard into a numeric keypad.

The built-in disk drive is a 3½-inch, 360K-byte drive located at the right rear of the case. Using a limited operating system called Microsoft Works 1.20, the drive can store text files or programs. For example, Microsoft Multiplan, a bundled spreadsheet program supplied in ROM (read-only memory), can be copied onto disk so that the ROM socket can be used for a custom application or for the optional BASIC ROM ($129.95). BASIC also can be saved to disk and loaded into RAM when needed.

All this hardware can be powered for up to 11 hours (with minimal disk activity) by built-in nicad (nickel-cadmium) batteries or by an external AC adapter/charger. The adapter/charger charges the nicad batteries up to a maximum of 14 hours when it is attached.

The other standard features of the Tandy 600 include an internal 300-bps (bits per second) modem with auto-dial/auto-answer and host modes, an expansion bus for an external disk drive, a parallel printer port, an RS-232C serial port, and a built-in clock that can power up the machine at a preset time to take a phone call or run an application.

TANDY 600 SOFTWARE

Bearing a coincidental resemblance to the DeskMate software that Tandy bundles with its MS-DOS computers, the Tandy 600's software features an operating system and five applications. The System Manager is a shell around Microsoft Works that handles file management for the disk drive and RAM. The five bundled applications are Word, a word processor whose files are compatible with the Microsoft word processor of the same name; Calendar, an alarm-driven appointment scheduler; File, a database manager; Telcom, for driving telecommunications activity; and Multiplan, reportedly a "99.5 percent version" of the IBM PC spreadsheet. In addition, a four-function memory calculator is available at any time as well as an

alarm function that can be preset to act as a reminder.

Microsoft Works was originally developed for the Heath ZP-150 laptop machine and looks vaguely like MS-DOS. Its functions are limited to formatting and copying disks, copying files from RAM to disk (or vice versa), listing or deleting files from RAM or disk, renaming files, and running applications. You invoke these functions by selection from a menu. The System Manager does allow wild-card characters in command operations. In spite of the passing resemblance to MS-DOS, however, the Tandy 600 disk format is not compatible with any other 3½-inch disk format. The System Manager also has a **Set** command to adjust the time for the sleep mode, to switch the machine's beep tone on and off, to preset power-up date and time for the wake-up mode, and to specify printer parameters (margins, page length and width, and continuous or sheet feed).

The text editor offers broader features than the rudimentary editors that came with the Model 100 and the Tandy 200. Called Word, this revamped editor provides more complete formatting functions, including right justification, multiple format lines, and automatic page numbering, plus enhanced editing commands like global search and replace. Liberal use of the function keys to implement a variety of text selection operations,

(continued)

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Photo 1: *The Tandy* 3000 *and the Tandy* 600.

The liveliest game in personal computers today is building IBM PC AT clones.

such as select word or select sentence, make copying, moving, and deleting text a simple operation. You can merge two documents and alter the format of any part of a document.

The appointment scheduler bundled with the Tandy 600 can be set to sound an alarm to remind users of appointments and will even display a text message at the bottom of the screen to explain the alarm. This Calendar application uses two calendar types: a month calendar and daily diaries. The diaries supply detailed information for individual days in the month calendars.

The Tandy 600's database manager, called File, can sort records alphabetically, numerically, or chronologically and search the database according to numerous search criteria. Each File database can provide up to 4095 records having up to 64 fields of up to 230 characters per field.

One of the most practical applications for a laptop computer is its use as a smart terminal for telecommunications. The Tandy 600's Telcom program drives an internal 300-bps modem and offers auto-answer, autodial, wake-up, and host modes. With the proper script, the Telcom software can turn the computer on, call another computer, and upload or download files to RAM or disk. It supports the XMODEM protocol for error detection during data transmission. Telcom displays its status (on-line or off-line) plus connect time on the Tandy 600's sixteenth screen line; this static display naturally draws the eye away from the scrolling text just above it and may confuse some first-time users.

Finally, there is Multiplan, extended from the Tandy 200 version to be very close to the IBM PC version. Multiplan data can be lifted from a spreadsheet and pasted into a Word document, and the program can generate SYLK files for transporting data to other programs. There are some limitations to this and all Tandy 600 applications; for example, the maximum size for any data file is 64K bytes.

OPERATION

The Tandy 600 features an automatic power-off, or sleep, function that turns the machine off after a user-selectable time period (the default setting is 5 minutes). Disk-intensive operations will decrease the time the machine can function on batteries between charges. One hour of disk I/O (input/output), for example, reduces the operating time between charges to 8 hours.

RAM in the Tandy 600 is battery-backed so that the machine can be turned off without losing the contents of memory. But the disk-storage capability of the machine will greatly ease the pressure to clutter up RAM with dozens of files.

An especially attractive feature is the potential for placing custom applications in the ROM slot occupied by the Multiplan ROM. Using standard 27256 EPROMs (erasable programmable read-only memories) and a Molex chip carrier for easy removal/insertion of chips, you can plug in any new application designed to run on the Tandy 600. Software developers can get all the information necessary to customize 8088 applications from the owner's manual or the separate hardware service manual (available for "less than $25").

Tandy supplies a 302-page, indexed, spiral-bound owner's manual that is organized by application. Each section provides a quick reference to that application's functions, followed by an extensive tutorial.

THE TANDY 3000

The liveliest game in personal computers today is building clones of IBM's PC AT. At least a dozen clones had been announced through September of this year and most offered something IBM didn't. The only surprising thing about the Tandy AT clone, called the Tandy 3000, is that it took the company so long to get the machine to market.

Made by Tandy in Fort Worth, the Tandy 3000 claims a 33 percent speed increase over the AT due to a higher clock speed (8 MHz versus 6 MHz) and single-wait-state operation (as opposed to two wait states in the AT). A standard Tandy 3000 offers 512K bytes of RAM and a 20-megabyte hard disk and a 1.2-megabyte floppy disk. The cabinet has room for an additional disk drive, either fixed or floppy. The machine supports four disk drives altogether, two fixed and two floppy, including a 360K-byte floppy.

A Tandy 3000 with two floppy drives, one 360K-byte and one 1.2-megabyte quad-density drive, costs $2599. The same machine with a 20-megabyte fixed-disk drive in place of one of the floppy drives carries a $3599 price tag.

RAM in the Tandy 3000 is expandable to a full 16 megabytes; the motherboard holds 640K bytes (using 256K-byte dynamic RAMs) and 2-megabyte expansion boards are scheduled for January 1986 shipment. These memory-expansion boards can occupy up to six AT expansion slots; two XT slots are available as well.

Other standard equipment includes battery-backed CMOS RAM and a real-time clock, plus a serial/parallel adapter that uses an XT-compatible expansion half-slot to provide one serial and one parallel port. The keyboard is a copy of the AT keyboard and is not compatible with the Tandy 1000/2000 keyboard.

To reduce the cost of the computer, Tandy engineers eliminated the key that disables the keyboard and locks the case of an AT. Utilizing 256K-byte dynamic RAMs reduces power demands sufficiently to allow the use of a 175-watt power supply. The power supply is switchable between 120- and 240-volt operation via a Molex jumper inside the power supply's case. A two-speed, thermostatically controlled fan cools the internal

(continued)

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BY ROY E. KIMBRELL

ENGLISH RECOGNITION

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Plain English is hardly ever used to communicate with a computer. This is unfortunate because it can be very effective, and programs that recognize and use relatively complex English sentences have been written for microcomputers. English gives you a variety of ways to express complex actions with a minimum of training and program interaction. Menus, on the other hand, are often highly complex and cumbersome—both for the user and the programmer. Special languages are difficult to learn and to design and implement correctly.

Some applications seem to demand a natural-language controlling mechanism (for example, database programs and games). When you design these kinds of programs, it is hard to predict the questions or commands a user might enter. Even in the largest and most expensive custom database systems, there always seem to be questions outside the scope of the programming.

However, English *has* been used successfully to control database programs. The first public success was LUNAR (Lunar Sciences Natural-Language Information System), which allowed scientists to query a large file of physical and chemical data on the lunar rock samples brought back by the Apollo 17 mission in December 1972. More recently, Larry Harris of Artificial Intelligence Corporation has been successfully selling a database-retrieval system called ROBOT (now INTELLECT) that uses natural English. It runs on IBM machines and licenses for tens of thousands of dollars. R:base CLOUT by MicroRIM, another English-based database-retrieval system, runs on microcomputers, but it's not cheap either.

Several game designers have recognized the benefits of using English to communicate with computers and have tried to use it as their controlling mechanism. However, the approach they take seems a bit limited. The games often have trouble recognizing what should be valid directions or questions by the players.

(continued)

Roy E. Kimbrell is a senior programmer/analyst with Planning Research Corporation (1410 Wall St., Bellevue, NE 68005). He has one M.S. in computer science from the University of Nebraska and another in meteorology from Creighton University.



ILLUSTRATED BY JERZY KOLACZ

Both games and database programs must be able to react in many complex and unpredictable ways. You can achieve this versatility by creating a library of functions or routines that do fundamental things. The user must be able to combine these functions in an endless variety of ways. English recognition is a surprisingly useful tool for this; it has been used in university labs for years. Its techniques have been developed to the extent that now you can apply them even on microcomputers.

ENGLISH RECOGNITION

There are two parts to applying English understanding to an application. The first is *recognition*—observing that the text forms grammatically correct English sentences and identifying such elements as subjects and verbs. The second part is *understanding*—the ability to react to a sentence in a meaningful manner.

Suppose we have a program named Higgins (after Professor Henry Higgins of *My Fair Lady* fame), a fictional expert in the science of speech. And suppose Higgins knows about wines; that is, it interfaces with a wine database. A question such as "How much does a 1976 bottle of Cabernet Sauvignon cost?" should be meaningful to Higgins, while "Where can I find a date for tonight?" would not be, even though it is a respectable English sentence. Higgins has files of data on wines and knows the name for each field in those records, but it knows about nothing else. It has no way of understanding anything about "date" or "tonight."

Higgins can recognize valid English sentences and break them up into identified pieces. It identifies the subjects, verbs, and other parts of speech in a manner that makes them usable in other parts of the program. Once the information is recognized, using it to do something can be easy.

Database questions can be simple. Higgins's verbs are usually forms of "to be" or "to do." Its subjects are usually either "wh-" words such as who, when, or where, or phrases such as how much. The objects with their

Adjective (ADJ)
    Examples: red, heavy

Binder (BINDER)
    Words: because, so, since, until, before, while

Complement (COMP)
    Words: that, to, whether, for

Conjunction (CONJ)
    Words: and, or

Determiner (DET)
    Number: *singular* (S), plural (P)
    Question: yes (Y), *no* (N)
    Words: a, an, each, every, few (P), her (SP), his (SP), how many (PY), its (SP), many (P), most (P), my (SP), no, our (SP), some (P), that, the (SP), their (SP), these (P), this, those (P), what (SPY), which (SPY), whose (SPY)

Noun (NOUN)
    Number: *singular*, plural
    Case: *subjective* (SUBJ), *objective* (OBJ), possessive (POSS)
    Examples: sky, house, committee's (POSS), sheep (singular, plural)

Number (NUMBER)
    Examples: first, second, third, twenty-one

Preposition (PREP)
    Words: in, on, at, for, without, next to, in spite of, in between, by, to, of

Pronoun (PRON)
    Number: *singular*, plural
    Person: first, second, *third*
    Case: *SUBJ*, *OBJ*, POSS
    Question: yes, *no*
    Words:

	SUBJ	OBJ	POSS, OBJ
first	I	me, myself	mine
second	you	you, yourself	yours
third	she	her, herself	hers
third	he	him, himself	his
third	it	it, itself	its
first plural	we	us, ourselves	ours
second plural	you	you, yourselves	yours
third plural	they	them, themselves	theirs

OBJ: this, that, these (plural), those (plural)
OBJ, yes: who, whom, whose, what
SUBJ, OBJ: Pick one from each column.

any	thing
some	body
every	one
no	where
	place
	time
	how

Figure 1: *The definitions of the various word types according to Higgins. Italics indicate defau*

Verb (VERB)

Type: *nonauxiliary* (NONAUX), to be (BE), to do (DO), to have (HAVE), modal (MODAL)

Form: *infinitive* (INFIN), *present* (PRES), past (PAST), present participle (PRESPART), past participle (PASTPART), third-person present singular (THIRDSING)

Transitivity (Trans): intransitive (INTRANS) — no object; *transitive* (TRANS) — one object; bitransitive (BITRANS) — two objects

Most verbs are nonauxiliary, and a common dictionary can give their forms and transitivities. Transitivity is expanded a bit in Higgins with the addition of "bitransitive." "Gave," as in "I gave my love a cherry," is bitransitive. Although the default transitivity is TRANS, it wouldn't hurt to define each verb as all three, INTRANS, TRANS, and BITRANS. Although this will allow some nonsensical sentences, it might be a great simplification. Because of this, transitivity isn't specified for the verb descriptions below. MODAL verbs are "helping" verbs and work in conjunction with other verbs.

BE:

be	INFIN
am, are	PRES
was, were	PAST
being	PRESPART
been	PASTPART
is	THIRDSING

DO:

do	INFIN, PRES
did	PAST
doing	PRESPART
done	PASTPART
does	THIRDSING

HAVE:

have	INFIN, PRES
had	PAST, PASTPART
having	PRESPART
has	THIRDSING

MODAL: Words: can, could, may, might, shall, should, will, would, must. *All BE, DO, and HAVE verbs are also MODAL.*

Particles: This is not a type; a particle is a sequence of words used as a single word; for example, "next to" is used as a preposition. Particles are used mostly as prepositions, verbs, and determiners, although nouns, especially proper nouns, are frequently particles.

Determiners: how many, all the, all this, all these, and other combinations of "all" and a determiner

Half a, half an, and other combinations of "half" and a determiner

Prepositions: next to, in spite of, in between

Verbs: Pick one from each column.

put	out
turn	on
get, got	off
get it, got it	in
go, went, gone	up
take, took	down
shut	away
come, came	around

descriptive modifiers are found in the database. In the sentence about the bottle of wine, Higgins considers "bottle" and "cost" to be objects with the limitations on "bottle" that it be Cabernet Sauvignon and 1976. "Bottle" is the key to one or more fields in a bottle record on specific wines in the database. Though several fields may need to be searched, the name Cabernet Sauvignon can be found.

PATTERN MATCHING

Recognizing English is a matter of pattern matching. The patterns of a language are what we refer to when we say someone speaks a foreign language well or when we complain of ungrammatical speech. Patterns occur in poetry as well, but these are as much a matter of the poem's *meaning* as they are of how the words are connected in phrases and sentences. The patterns we are looking for are word patterns—the patterns of English grammar.

One tool we use in pattern matching is the ATN (augmented transition network). It's been around a long time and has proved itself valuable in a variety of applications. For a discussion of how to build and use Higgins's networks, see the text box "English Grammar Network" on page 128.

THE GRAMMAR AND THE DICTIONARY

The basic unit used in Higgins is the individual word (see figure 1). [*Editor's note: C-language source listings of* HIGGINS.C, BTREE.C, BTREE.H, *and* DICT.H *are available for downloading on* BYTE*net listings,* (617) 861-9764.] In the grammar we'll use, there are the traditional types of words: nouns, verbs, and adjectives. There are also some rather special types: relatives, binders, complements, determiners, and others. In Higgins's dictionary, words are divided into 12 types. All but three of them have a limited number of words. Nouns (including proper nouns), adjectives, and verbs make up the bulk of English words. A word may be used in several different ways and therefore may have several different types.

(continued)

ENGLISH GRAMMAR NETWORK

Figures A and B provide examples of simple networks. Figure A recognizes the word "cat." A circle with a number in it is called a *state* and a curved arrow with a letter beside it is called a *transition*. In this network the program starts in state0 and reads characters. If the next character read is a "c," the program goes on to state1, otherwise it reports failure and quits. If the program reaches state3 (the double-circled state), it reports success.

Figure B recognizes either "cat" or "cow." In state1, if the next character is an "a," the program takes the transition to state2; if it is an "o," it takes the transition to state4; if it is something else, the program reports failure. If the program reaches state3, it recognizes "cat"; if it reaches state5, "cow."

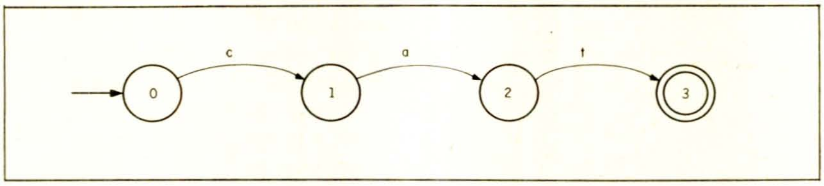


Figure A: A *simple network that recognizes the word "cat."*

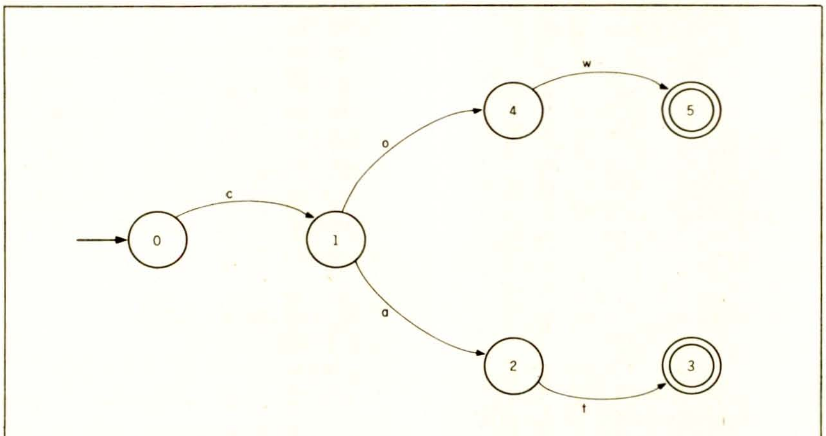


Figure B: A *simple network that recognizes either "cat" or "cow."*

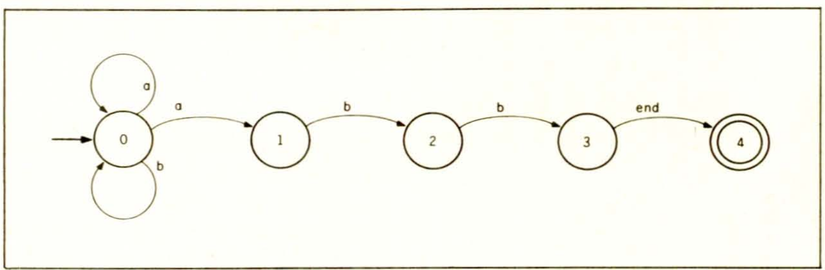


Figure C: *This network involves relaxing the rule that requires a unique set of transition values on each arc. Since there are two "a" transitions, the network follows both.*

Networks can match more than just simple character strings. The value used to decide which, if any, transition to take can be a single character, a class of characters, a word, or a class of words. You can use this kind of network to write a recognizer for a computer language where each transition is based on specific words (reserved words) or on categories of words (variables, numbers, strings, and so on). In fact, this idea is basic to the way many compilers are actually written.

In figures A and B, each transition has a unique value at each state. But if duplicate transition values aren't allowed, the network can become exceedingly complex. Look at figure C. This network matches character strings composed of an unlimited number of "a" and "b" characters followed by the sequence "abb." Compare figures C and D. They both match the same string of characters, but figure D is obviously more complex. In the network in figure C, the question is which of the two "a" transitions to take out of state0. The answer is, both of them.

You need a simple mechanism for following several paths simultaneously as you read transition values (characters, words, or whatever). If there is a failure, an improper value encountered at one of the states, you stop traveling that particular path but continue all other paths as long as you are reading valid transition values. If you stop traveling all paths, then you report a failure. Eventually, you either reach the end of the string or reach a success state along some path.

Take the case of the network in figure C. Suppose the string you are going to test is "ababb." You read the first "a" and go to both state0 and state1. Then you read the first "b" and go to both state0 and state2. Next you read the second "a" and quit at state2 but continue at state0 and go to state1. When

you read the second "b," you continue at state0 and go to state2. Then you read the last "b" and stay at state0 and go to state3. Finally, you read the end of the string and quit at state0 but report success at state4.

Writing a Network Recursively

There is a simple mechanism for traveling several paths—recursion. Although it isn't simultaneous, the effect is the same. Look at listing A. A state is now a separate *function* that tests its transition values and either calls the next function or reports failure. Where you can take several transitions on the same value (as in state0), a reported failure along one path simply allows the program to try other paths.

In the function state0 in listing A, *location* is a local variable because integers are passed by value. When you first call state0, the calling line of code might look like this:

```
if (state0("ababb",0)) success();
```

In other words, the variable *location* is initially 0.

State0 checks the first character. If it is an "a," state0 calls state1 passing it the string and the location of the next character. If state1 returns success, then state0 can report success because state1 can be successful only if state2 and state3 are also successful. If the character checked in state0 is a "b," state0 calls itself (recursively) with the location of the next character. If the character is neither an "a" nor a "b," it is an invalid character and state0 reports a failure. This failure never occurs in a valid string of characters because the transitions to state1 and beyond are tested first and given a chance to succeed.

The recursive method has considerable advantages in simplicity. The amount of code necessary to implement a network is considerably less when the network allows duplicate transition values than when it does not.

(continued)

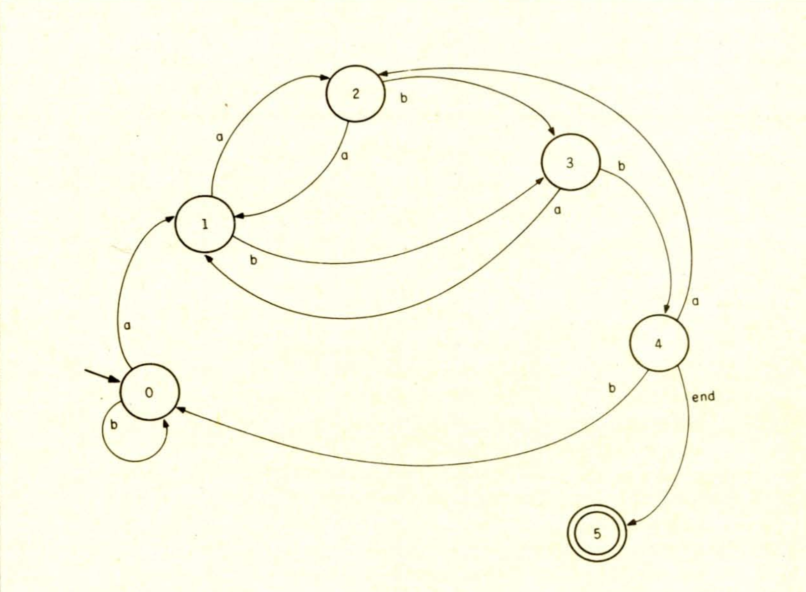


Figure D: *This network performs the same function as the one in figure C. However, it is much more complex because it has a unique transition value on each arc and follows only one path.*

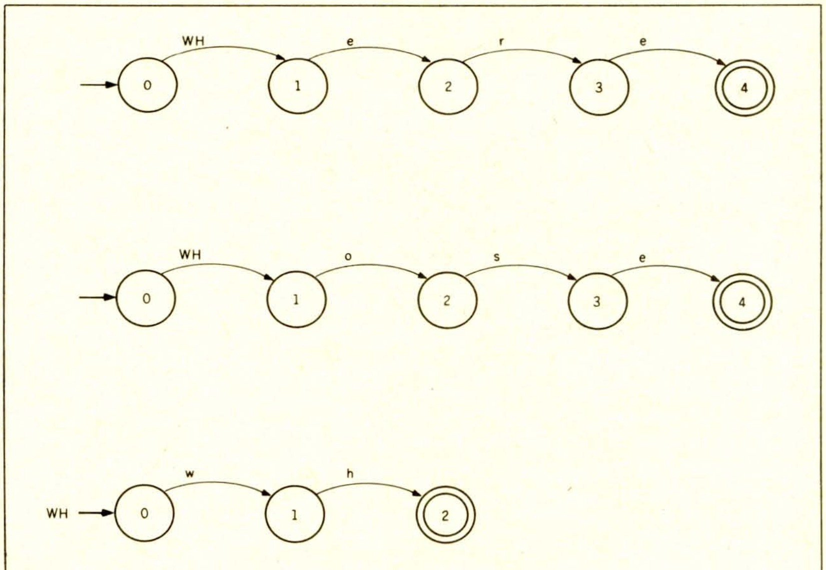


Figure E: *The* WH *network replaces two arcs and states and matches "wh."*

Interestingly, both kinds of networks are equally powerful in describing and matching patterns.

SUBNETWORKS

Calling a state as a subroutine or function has other advantages. You can build networks where a transition from one state to the next depends on the successful matching of an entire network, not just the matching of a single transition value. For example, look at figures E and F. The network matches "where" or "whose" but the "er" and "os" are recognized by a subnetwork. If the network reaches a success state, it has matched either "where" or "whose."

A collection, or *packet*, of information created as the network runs is a convenient mechanism for keeping track of the path taken. (The C language calls them structures; in Pascal they are records.) Because you don't want to limit the system's ability to process very long data strings, you usually allocate storage for the packets from the run-time heap and fill them with information as the called network processes the data string. If the called network is unsuccessful, it frees the storage used by the packets and reports failure. If the called network is successful, it reports success and returns a pointer to the string of information packets. Once a subnetwork—or any network—has completed its task, the packet contains the significant information found during the matching process.

For English recognition, the packets must have a description that varies depending on the kind of information placed in them. Understanding how to use this information requires some comprehension of the reasons behind the design of a network that recognizes valid English sentences. Such a network is based on English grammar.

Listing A: *A pseudocode implementation of the pattern matching described by figure C. A transition to a new state is made by recursively calling the next state. Although the paths aren't taken simultaneously, the effect is the same, since the local variables at each state keep a current-place marker in the string being tested.*

```
function state0: arguments -
                        string, an array of characters.
                        location, an integer.
   if the character at location in string is 'a',
      call state1 passing string, location+1.
      if state1 returns success, return success.
      otherwise, call state0 passing string, location+1.
      if state0 returns success, return success.
      otherwise, fail.
   if the character at location in string is 'b',
      call state0 passing string, location+1.
      if state0 returns success, return success.
      otherwise, fail.
   otherwise, fail.
function state1: arguments -
                        string, an array of characters.
                        location, an integer.
   if the character at location in string is 'b',
      call state2 passing string, location + 1.
      if state2 returns success, return success.
      otherwise, fail.
   otherwise, fail.
function state2: arguments -
                        string, an array of characters.
                        location, an integer.
   if the character at location in string is 'b',
      call state3 passing string, location+1.
      if state3 returns success, return success.
      otherwise, fail.
   otherwise, fail.
function state3: arguments -
                        string, an array of characters.
                        location, an integer.
   if the character at location in string is end,
      call state4 passing string, location+1.
      if state4 returns success, return success.
      otherwise, fail.
   otherwise, fail.
function state4: arguments -
                        string, an array of characters.
                        location, an integer.
   return success.
```

GRAMMAR LIKE YOU NEVER SAW IN SCHOOL

We humans are extraordinary pattern matchers. We quickly recognize shapes and sounds and even large and complex combinations of shapes and sounds. We also have the ability to create these patterns. A pattern is a set of rules. We create shapes and sounds that *fit* patterns—that is, we create according to a set of rules (even if the rules aren't well understood).

English grammar works the same way. The grammar is the pattern you use to create and understand English sentences. It is also basically the pattern you use to write a program that recognizes English sentences. (The grammar used by Higgins is a bit permissive—it lets a few ungrammatical things pass by.)

Higgins's grammar is based on networks, but instead of going from one state to another based upon a specific character, the transition is based on word type. Examples of these networks are in figures G and H and in table A. The program might make a transition based on whether the incoming word is a noun, a verb, or another kind of

word. The program can also make a transition based on whether the next sequence of words matches a pattern—a pattern defined by a subnetwork.

When making a transition based upon a single word, the program looks up the word in the system dictionary to determine its type (noun, verb, adjective, or preposition). There are also some rather special kinds of words that might be unfamiliar—relatives, binders, complements, determiners, and others. Luckily, these groups of words are small, and once you enter them into the dictionary, you can usually ignore them.

All of the words the recognizer program might encounter must be in the dictionary. It doesn't really understand English and can't use the context of the sentence to make any guesses about what the word might mean. Some recognizers have the ability to ask about the type of an unfamiliar word. Since most of the words not in the dictionary are usually nouns and adjectives, this is a reasonably easy thing to do.

The network grammar for English that Higgins uses is close to one developed by Terry Winograd and described in considerable detail in his *Language As a Cognitive Process*. Higgins's grammar bears considerable resemblance to others that are similarly constructed, such as the network grammar used in LUNAR. The purpose of Winograd's grammar is to *define* English syntax. This is a little different from only trying to *recognize* valid English. However, it works well in a large variety of situations and applications.

Making a transition based on word type is easy. You look the word up in the dictionary. If one of its usages corresponds to the one demanded by the transition (and some possible other conditions are met), then you take the transition.

Some other conditions are usually checked also. These conditions may vary at each state. They are special checks that ensure that the path taken is valid. They are often important in deciding which of several possible paths to take. In addition, most states require special actions. These are all associated with recording information about the sentence or phrase in the

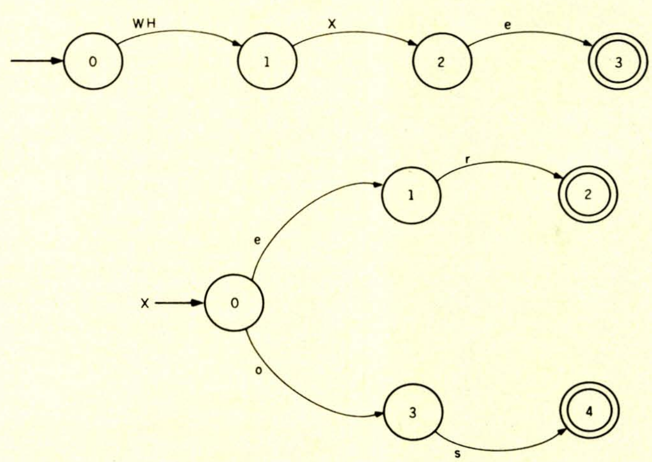


Figure F: *The* X *subnetwork replaces arcs and states matching either "er" or "os."*

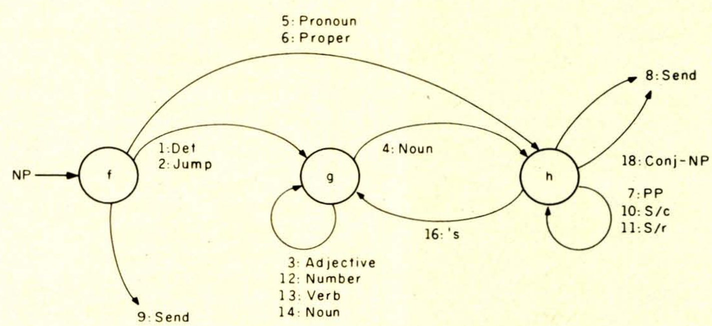


Figure G: *The* NP *(noun phrase) network.*

packets. Sometimes the actions create implied constructions, such as the "you" implied in the sentence "Go!"

The transitions based on matching a network are similar. Instead of matching a word type, you match a network. When making a transition based on word type, each transition uses up one word. That is, the first word in the sentence is checked at the first state, the second word at the second, and so forth. When making transitions based on matching a network, you use up as many words as necessary to make the match. If you fail to find a match, then no words are used up.

The networks in figures G and H are examples of networks used to describe a grammar. Table A specifies the conditions and actions associated with the transitions of the NP (noun phrase) network.

English sentences are built from noun phrases, prepositional phrases, and verb phrases. A noun phrase describes the actor in a sentence or perhaps the person, place, or thing acted upon. The NP (noun phrase) network (see figure G and table A) builds an NP packet that contains pointers to determiner (Det), header

(continued)

(Head), describer (Desc), and qualifier (Qual) packets. These are packets returned from calls to the other networks. The NP packet has places for four features: number (Num), Person, question (Ques), and Case. Num may be singular or plural, no default. Person may be first, second, or third, default third. Ques may be yes or no, default no. Case may be SUBJ (subjective), OBJ (objective), or POSS (possessive), no default. The current word under examination is kept in a packet of its own. The values in the packet are filled from the dictionary. The features of the current-word packet depend on the type of the current word.

Associated with each arc in the network are initialize: (initializations), if: (conditions), and then: (actions). See table A. Any of these may be absent. The initializations require the definition of a new packet before calling a subnetwork. The packet is empty except for defaults and the initializations. The conditions are checked after the word type on the arc has been matched with the current word or the subnetwork on the arc has reported success and has returned a packet. The current word may enter into these conditions. If the conditions are met, the actions are taken, and a transition to the next state may be made.

Hold is a global variable used to temporarily hold a copy of a packet. When the copy is made, the source of the copy must be made empty as its emptiness is a flag for further action. Likewise, if Hold is copied somewhere, it must also be emptied.

Table A: *The transitions of the* NP *network.*

```
 1. then:  NP.Num = current-word.Num;
           NP.Ques = current-word.Ques;  NP.Det = current-word;
 2. none.
 3. then:  Append current-word to NP.Desc;
 4. if:  current-word.Num = = NP.Num or NP.Num is empty;
    then:  NP.Num = current-word.Num; NP. Head = current-word;
 5. then:  NP.Num = current-word.Num;
           NP.Person = current-word.Person;  NP.Ques = current-word.Ques;
           NP.Head = current-word;
 6. then:  NP.Num = current-word.Num;  NP.Head = current-word;
 7. then:  Append current-word to NP.Qual;
 8. then:  Success; NP. Case = NP.Head.Case;  return the NP packet;
 9. if:  Hold is an NP;
    then: Success; Empty and return Hold;
10. initialize:  S/c.Subj = copy of the current NP packet;
                 S/c.Mood = REL;  S/c.MV = dummy VP = "to be"
                 dictionary values;
    then: Append S/c to NP.Qual;
11. initialize:  Hold = copy of the current NP packet;
                 S/r.Mood = WHREL;
    then: Append S/r to NP.Qual;
12. then:  Append current-word to NP.Desc;
13. if:  VP.Form == PRESPART or PASTPART;
    then: Append VP to NP.Desc;
14. if:  current-word.Num == SINGULAR;
    then: Append current-word to NP.Desc;
15. not used.
16. if:  NP.Head is not a pronoun;
      Note:  The only thing being tested on this arc is the occurrence of the
      string  's indicating possession (POSS).
    then: Create a new NP packet;  copy the current NP packet
          into the new NP packet;  new-NP.Case = POSS;
          set all NP values to defaults;  NP.Det = new-NP;
17. not used.
18. Note:  If the current word is a conjunction, then the NP network is
      recursively  called; if an NP is returned, form a list of these NPs.
```

A prepositional phrase is a sequence of words containing a noun phrase and beginning with a preposition. Its purpose is to modify or qualify a noun phrase. The PP (prepositional phrase) network builds a PP packet, which contains pointers to Prep (preposition) and Prepobj (preposition object) packets. These are either packets returned from calls to the NP network or current-word packets.

The verb phrase describes the action taken in a sentence. It might be a single verb or a series of words. The VP (verb phrase) network builds a VP packet that has pointers to Verb packets, current-word packets of type Verb. They form a list starting at the VP.Verbs (verb phrase.verbs) pointer. Similar to a verb, the VP packet has Form (tense), transitivity (Trans), and Type features. Form may be INFIN (infinitive), PRESENT (present), PAST (past), PASTPART (past participle), PRESPART (present participle), or THIRDSING (third person present singular). Trans may be INTRANS (intransitive), TRANS (transitive), or BITRANS (bitransitive). Type may be NONAUX (nonauxiliary, that is, acting alone), BE, DO, HAVE, or MODAL (supportive words, such as "can," "could," "may," "should," "must," etc.).

The S/ (sentence) network builds a packet, S, that has places for pointers to Subj (subject), DO (direct object), IO (indirect object), MV (main verb), Binder (binder), Auxs (auxiliaries), Mods (modifiers), and QE (question element) packets. These are the packets returned from the NP, PP, VP, and S/ networks. It also has places for two features: voice and mood. The voice may be ACTIVE or PASSIVE, default ACTIVE. The mood may be DECL (declarative), INT (interrogative), IMPER (imperative), BOUND (bound by a binder), REL (relative), or WHREL (who, what, why, where, when relative), default DECL. These features are used to report the form of the sentence and to direct processing.

The S/ network is shown in figure H. NP, PP, VP, S/, Jump, and Send refer to either a network to be entered or to special transitions to be taken. The other labels (Noun, Verb, Particle, Binder, Rel, and so forth) are all word types or usages.

The NP, VP, and PP networks match noun phrases, prepositional phrases, and verb phrases. The S/ network is

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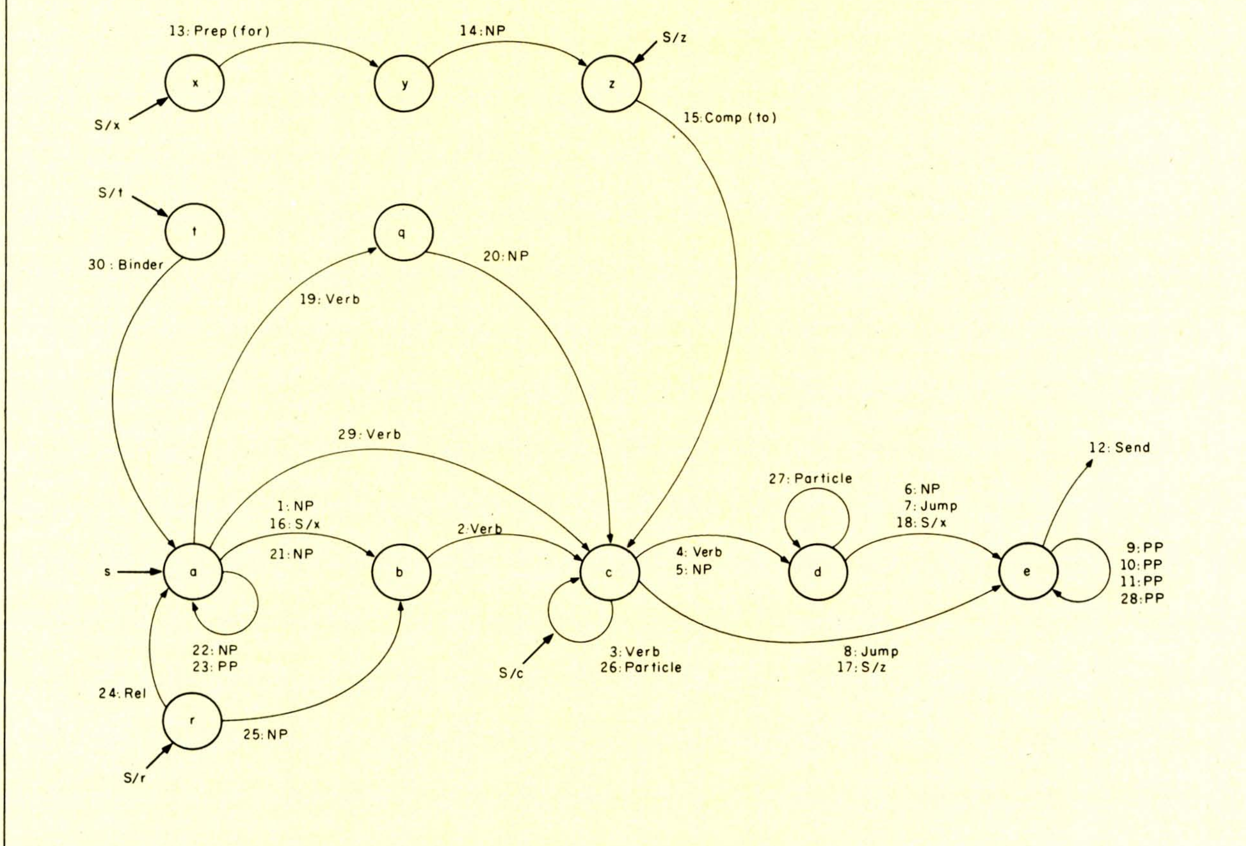


Figure H: *The S/ (sentence) network.*

rather special. The main (sentence) network can be entered at the state designated by the letter following the slant (e.g., S/x is entered at statex). This is a recursive call and control returns to the *calling* state, not statea, just as if the NP or PP network were called. If the use of the S/ network call seems far-fetched, consider "For Joe to eat spicy food is unusual." The phrase "For Joe to eat spicy food" is matched by the S/x network.

The Jump and Send transitions are special in that they don't match a word or phrase. The Jump only asks that the special conditions be met; if they are, the transition is made without reading the current word, which is then tried at the next transition.

The Send transition isn't really a transition at all. It is used to report success. If the special conditions at the state are met, the special actions are carried out and a success indication is returned to the calling state. If control returns to the caller of statea, a sentence has been recognized. The return goes through all of the states called before it reaches the Send transition.

The simplest sentence matched by the network is a one-word sentence, such as "Go!" or "Run!" Statea is called (see figure H). Eventually, the Jump transition to stateb is taken, "go" or "run" is recognized as a verb, and the verb transition to statec is taken. After a few attempts, the Jump transition to statee is taken, where the Send transition is finally taken. Now, success is reported to statec, which reports success to stateb, which reports success to statea, which reports success to its caller. The sentence has been successfully analyzed.

Listing B: *A pseudocode representation of a typical (skeleton) state in Higgins.*

```
function state0:
    arguments -
        curword — points to the current word packet.
        packet — points to the packet to be filled in.

— An attempt to make a transition based on matching a word type:
if curword is a NOUN, — or whatever. . .
    if special conditions,
        perform special actions.
        call state1(curword.next, packet).
        if state1 returns success,
           return success and the packet.

— An attempt to make a transition based on a subnetwork's success:
create an NP-packet.
call NP(curword, NP-packet).
if NP returns success,
    — Presumably, curword has been modified to point to a
      word past the sequence matched by the subnetwork.
    if special conditions,
        perform special actions.
        call state2(curword, packet).
        if state2 returns success,
           return success and the packet.

— A Jump:
if special conditions,
    perform special actions.
    call state3(curword, packet).
    if state3 returns success,
        return success and the packet.

— A Send:
if special conditions,
    perform special actions.
    return success and the packet.

— If we got this far, we've failed.
return failure.
```

CODING A RECOGNIZER

Listing B is a skeleton state. It shows, in pseudocode, how a state—actually the function representing the state—is programmed. It illustrates four kinds of transitions. The first is an attempt to make a transition to a new state based on the type of the current word; the second is an attempt to make a transition by calling a subnetwork; the third is a Jump—if the special conditions are met, make the transition without trying to match a word type or a subnetwork; and the fourth is a Send—success is reported. The actual coding will vary from this example, but the basic steps remain the same: If the word or phrase is of the requisite type, check the special conditions; if they are met, perform the special actions to save information and call the function representing the next state.

Much of the information saved comes from the dictionary. This information is kept in a large packet passed from state to state during the recognition process. When a network is called to recognize a phrase, an empty packet is created to hold the expected information. If the phrase is recognized, the packet is filled in and passed back to the calling state where it is appended to the calling state's packet. As a sentence is processed, the basic packet is filled in with pieces attached to it representing phrases recognized by the various subnetworks.

If success is reported from a call to a network, such as the NP network, the current position in the sentence is also returned so processing can continue following the matched phrase. If failure is reported, the position returned by the network is ignored.



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Direct commands	•	N/A	N/A	•	•
Maximum scientific digits of accuracy. (COS, SIN, ATN, LOG, EXP etc.)	6 to 54 selectable by the user	11 Binary BCD N/A	16	16	6
Device Indpdnt Graphics (same CMDS all graphic modes and computers)	•	N/A	N/A	N/A	N/A
SAME File commands all computers?	•	N/A	N/A	N/A	N/A
STRUCTURED: Labels, Functions, LONG IF etc.	•	•	N/A	•	N/A
Same editor commands all versions/computers	•	•	N/A	N/A	N/A
Sieve benchmark (Byte January 1983, 10 iter's)	13.7 sec.	14.1 sec.	14.9 sec.	261 sec.	2190 sec.
Shell-Metzner SORT (Sybex-BASIC for Scientist's and Eng. 2,000 5 char. strings)	19 sec.	28 sec.	71 sec.	194 sec.	2700 sec.
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Comparisons can be difficult for Higgins because they often imply so much.

"Bordeaux" is the name of a place and is therefore a noun, but it can also be an adjective, as in "the Bordeaux wine." A word may also have one or more features depending on its type, and it may have more than one value for a single feature. For example, Noun.Number of "sheep" is both singular and plural. A noun's case feature is most often both subjective and objective.

When Higgins reads the definition of a word from its dictionary, it builds a packet similar to the sentence, noun phrase, and other packets. The type of the packet is the type of the word.

Unfortunately, some words are of more than one type; that is, they are used in more than one way. For example, "gun" is both a verb (gun the engine) and a noun (shoot the gun). The special types of words (relatives, binders, etc.) all make up a relatively small group. English is built mostly of nouns and adjectives with a lot of verbs added for good measure.

The words that are subclassified—the verbs, nouns, etc.—have several *feature values* within a subclassification. For example, "see" is both an infinitive form and a present form. These multiple feature values are critical to Higgins's operation. It is often important for a verb to have all of its relevant feature values defined in Higgins's dictionary in order to process a sentence properly. This is especially true of the "to be" type verbs.

Adding feature values to words may blur the distinctions between grammatical and ungrammatical sentences. For example, if you want to ignore the difference between nouns and proper nouns, you might type each noun as both. Comparisons are a little difficult for Higgins because a sentence containing comparisons often *implies* so much. To simplify this process, words such as "greater" and "than" are typed as verbs (in addition to their other types). Their verb features are present, past, and modal, and the phrase "is greater than" is recognized as a sequence of verbs.

The features in the packet are filled in from the dictionary entry. The allowable values for each feature are also specified in figure 1; the default value, if there is one, is shown in italics.

The Analysis of a Sentence

Recognition of a sentence—including filling the packets with information from the sentence—makes understanding possible. The packet structure created during sentence analysis is a tree. As the sentence is scanned via successful transitions through the networks, packets are added to the structure. When finished, the completed structure parallels the successful path through the network. In keeping with the tree structure, let's call a packet a node.

The primary node is the sentence node. It has places for recording voice and mood information and places for pointers to other nodes. The other nodes describe the sentence's subject (there is always a subject, although it may be implied), verb (there is always a verb), and any of several other dimensions. The objects, if they exist, specify what is to be acted upon. The auxiliaries, if there are any, are helping verbs, such as "will have been" in the sentence "By tomorrow, the cat will have been drinking from the cup." The main verb is "drinking." Modifiers such as "from the cup" are attached to the sentence node when they modify the sentence. If they modify a part of the sentence, they are attached to the node representing that part of the sentence.

The parts of a sentence are represented by nodes. The subject and objects are noun-phrase nodes; the verb is a verb-phrase node; and the modifiers are prepositional-phrase nodes. There is one exception. In the place of a noun- or prepositional-phrase node, you may substitute a sentence node. For example, in "The cat who drank the wine went to sleep," "who drank the wine" qualifies the subject of the sentence and has the form of a sentence (a subject, "who"; a verb, "drank"; and an object, "the wine").

When you design a program to use the information Higgins provides, remember the model of the sentence: subject, verb, and possible objects. In the sentence "How much does a bottle of Cabernet Sauvignon cost?" according to Higgins the subject is "how much," the verb is "does," and the objects are "a bottle of Cabernet Sauvignon" and "cost." If you were translating this into a database query, it might come out: SELECT COST FROM WINELIST WHERE NAME = "Cabernet Sauvignon." In making this translation, you assume a lot about what the user might be asking, the possible range of queries, and the possible range of subject matter. You can make these kinds of simplifying assumptions because anything outside this range of information wouldn't be understood anyway—it wouldn't be in the database.

Higgins is a powerful tool for an application program in understanding the language used in framing sentences. Once the purpose of the program is clearly understood, you can put a variety of sentences through your version of Higgins to see how it stores them in its packets. When you understand this, you can write the part of the program that does the real work—perhaps with a version of Higgins at the beginning. Listing 1 shows an example sentence analyzed by a version of Higgins written in C.

Limitations and Peculiarities

When placing information in the packet, Higgins can make mistakes. The fault is not entirely Higgins's, though, because English is an ambiguous language. Its ambiguity is both its power and its failing. A sentence often quoted by grammarians is "Time flies like an arrow." If "time" is a noun (a thing), then "flies" must be a verb, and the

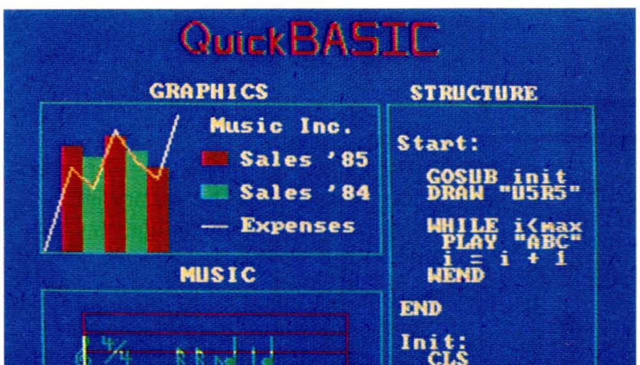
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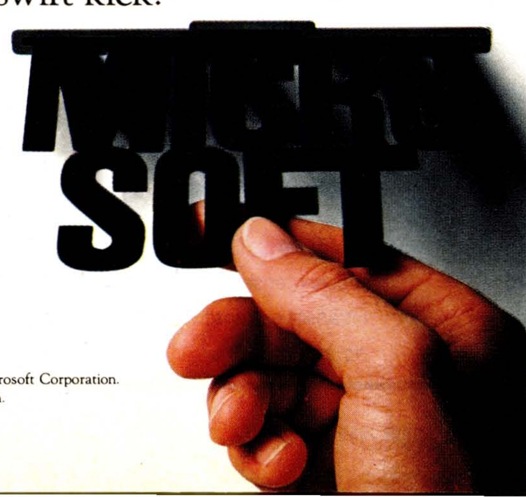
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sentence is modified by the prepositional phrase "like an arrow." If "time" is a verb, however, then the sentence is a command (an imperative sentence). The subject is an implied "you," and "like an arrow" describes how to time the flies (nouns, things). Whether this makes any sense is unimportant to Higgins. The program doesn't understand what the words mean, just how they fit together in English.

When we read or hear English, we process the words syntactically and semantically—by form and by meaning—at the same time so the ambiguity usually is not recognized. Therefore, the internal order Higgins uses in processing sentences may be of particular interest. To see how Higgins does it, try a few potentially ambiguous sentences. If Higgins doesn't process them the way you want it to, you may have to tinker with the code or perhaps simply limit the meanings of the words in the dictionary.

Some features of English are difficult to analyze without also incorporating a great deal of knowledge about sentence meaning and context into the program. Surprisingly simple English can confuse poor Higgins. One feature that Higgins knows very little about is the simple conjunction, such as "and" or "or." Higgins can handle noun and verb phrases with embedded conjunctions, but that's all. The problem occurs when parts of the sentences are only implied, not specified. You and I have no problem with these because we understand the meaning of the sentence and fill in the missing phrases easily. Higgins doesn't understand meanings and can't fill in anything. The following sentences were taken from Terry Winograd's book *Language As a Cognitive Process* (Addison-Wesley, 1981):

1. Paul and Joy came to dinner.
2. They brought some yellow and purple flowers.
3. They gave Joan a kiss and Eileen a hug.
4. We opened and drank some wine and ate falafel.
5. Paul liked to play tunes on the guitar, and Joy on the mandolin.
6. He played and she sang every old tune in the book.

The first sentence contains a simple conjunction between noun phrases—no problem for Higgins. The second sentence has a conjunction of adjectives; Higgins doesn't know how to analyze these, but it can be modified to do so. In the third sentence, "they gave" is understood to follow "and" ("They gave Joan a kiss and *they gave* Eileen a hug."). In the fourth sentence, "we" is understood to follow the "and." In the fifth sentence, "liked to play tunes" is understood to follow "Joy." Finally, in the sixth sentence,

(continued)

Listing 1: *The structure of packets built during sentence analysis. This example was created by an implementation of Higgins written in C. The exact form of the structure depends on the form of the sentence. See table 1 for the meanings associated with the numbers shown.*

```
What does the wine cost?

  Sentence: mood = 2, voice = 1
  S.Subject:
    Noun phrase: number = 2, person = 8, case = 6, question = 6
    NP.Determiner:
      Pronoun: "what" number = 2, person = 8, case = 6, question = 6
    NP.Head:
      Pronoun: "what" number = 2, person = 8, case = 6, question = 6
    S.Direct object:
      Noun phrase: number = 6, person = 8, case = 6, question = 4
      NP.Head:
        Noun: "cost" number = 6, case = 6
    S.Indirect object:
      Noun phrase: number = 2, person = 8, case = 6, question = 4
      NP.Determiner:
        Determiner: "the" number = 6, question = 4
      NP.Head:
        Noun: "wine" number = 2, case = 6
    S.Main verb:
      Verb phrase: form = 40, transitivity = e, type = a
      VP.Verbs:
        Verb: "does" form = 40, transitivity = e, type = a
```

Table 1: *The various numbers are hexadecimal representations of the binary values in that feature. The meaning of each bit is determined from the constant definitions in Higgins's implementation. For example, case=6 means both bit 1 and bit 2 are set on; this word can be either subjective or objective in its present form.*

mood = 2	interrogative
voice = 1	active
number = 2	singular
= 6	singular or plural
person = 8	third
case = 6	subjective or objective
question = 4	no
= 6	yes or no
form = 40	present tense
transitivity = e	intransitive, transitive, or bitransitive
type = a	do and modal

"every old tune in the book" is understood to follow "played." Higgins won't be able to do much with these kinds of sentences.

You can increase Higgins's abilities to analyze these sentences, but it is difficult to do things in a general way. You will encounter a host of details and special cases, but with some persistence you can successfully add a lot to your program's abilities.

Comparisons are also often difficult to analyze. The problem is much the same as that of the conjunctions—implied meanings and implied constructs. The comparisons implemented in Higgins depend on giving words such as "greater" and "than" modal features so that "is greater than" is analyzed as a verb phrase. Higgins understands "Find the boxes that have width greater than height," if you define "greater" as having a "to be" verb form. However, Higgins won't analyze "Find the boxes that have width greater than height and weigh more than 20 pounds" because of the implied construction following the "and." If you want to analyze these kinds of sentences, you'll have to add to Higgins's abilities.

A final sentence form that Higgins doesn't analyze is the compound sentence: "The cat drank the wine, and he had a hangover."

CONCLUSION

Higgins is based on pattern matching. This pattern matching uses a particular form of state network called ATN. The network is augmented by adding packet structures that are carried from state to state in the network. Network transitions from state to state are made by recursively calling the next state rather than by simply jumping to it. The call and return allow a simplicity of control at the programming level by placing the burden on the run-time system to keep track of local variables.

Higgins's design is open and simple enough to allow modification. You can add to its abilities to analyze English and keep more information in the packet structures. You can also modify the design to allow ungrammatical sentences and to merge various word types, such as nouns and proper nouns. In addition, you may assign words in the dictionary types and features in such a way that they pass tests they otherwise would not.

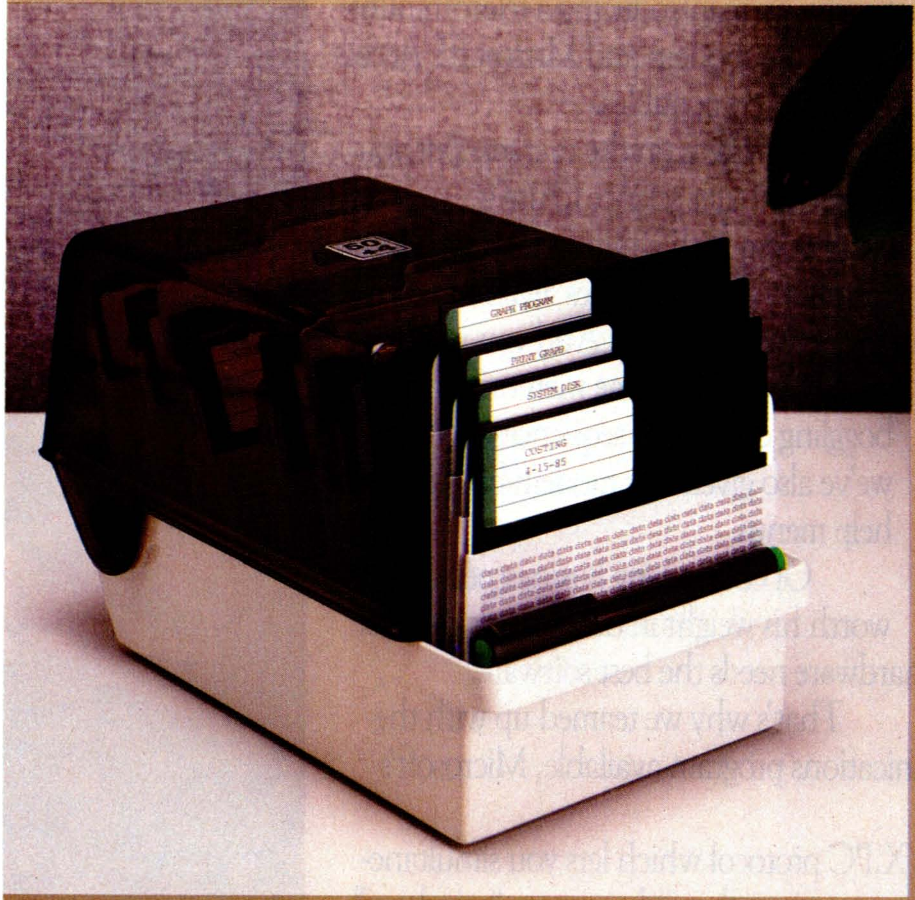
Higgins can be a powerful tool for understanding and using English as a part of an application program's operating ability. Remember, Higgins doesn't *do* anything, it just explains the sentence to you. And recognition is the first step toward understanding.

[*Editor's note: The networks described in the text box are documentation for Higgins. You can get a complete set by sending the author a large, self-addressed stamped (two stamps) envelope.*] ■

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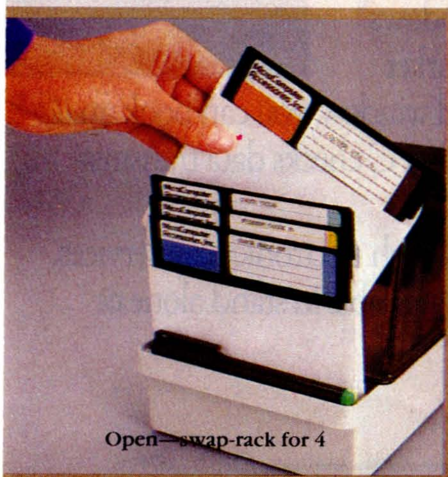
Holmes, it's criminal—these "sloppy disks" all over the desk! How can we keep them secure and dust-free and still have access to the active ones?

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By Jove, Holmes, open and shut simultaneously! It's perfect for those powerful integrated, multi-disks systems—and no one's thought of it before! Holmes, you never cease to amaze me.

Elementary, my dear Watson.

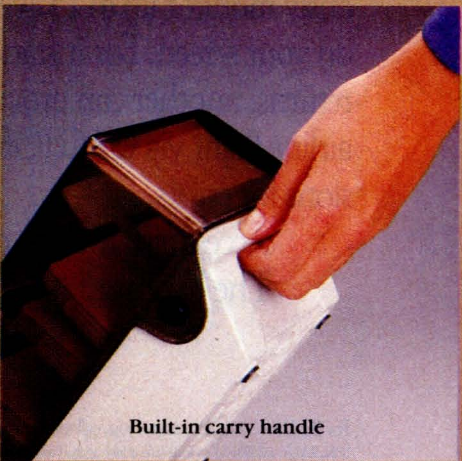
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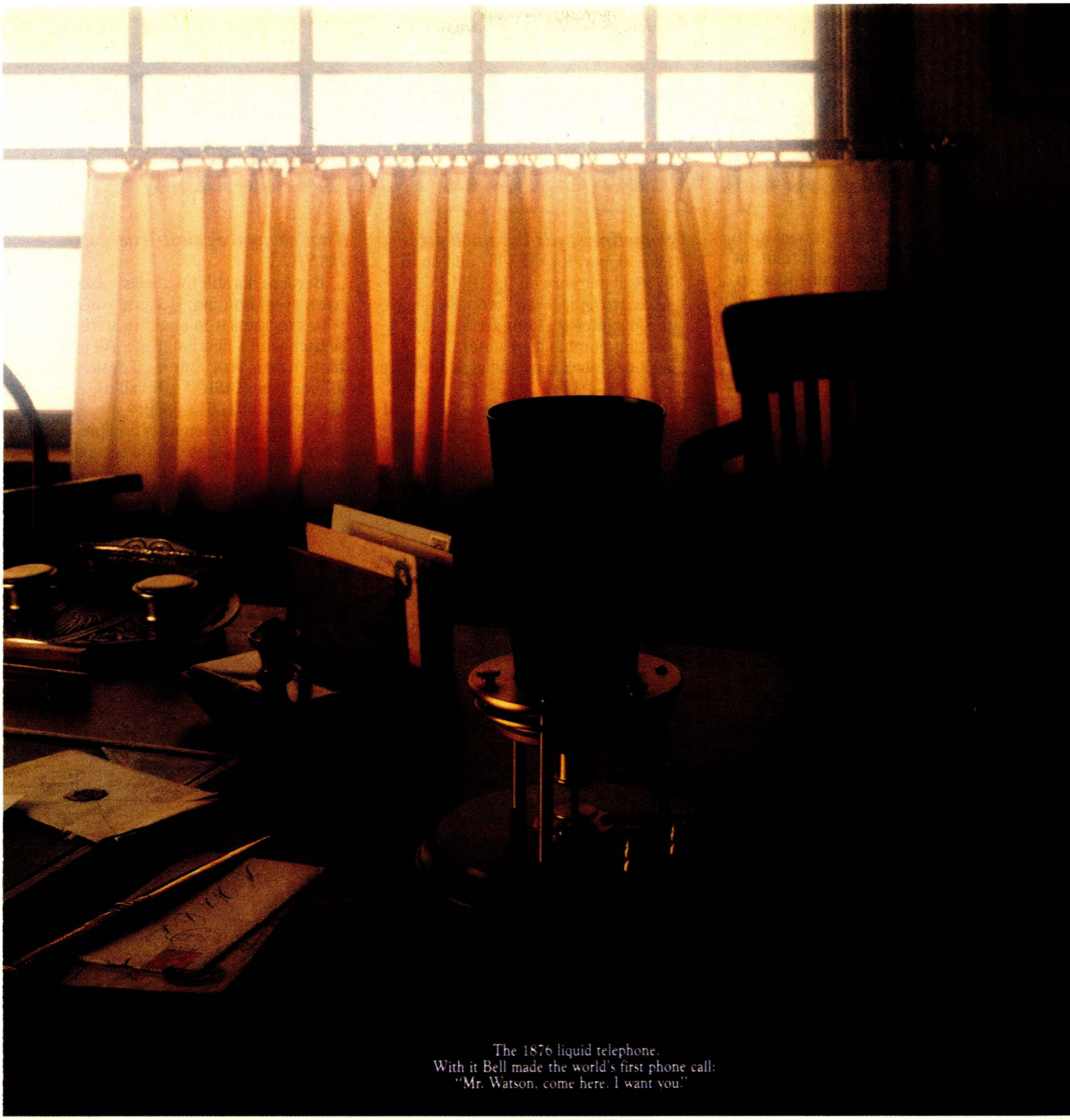


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ON-LINE DATABASES

It is often difficult to find the "right" software by means of a database search because of the general lack of precision of the search process. Either the number of "hits" will be large and most citations will prove to be of marginal value, or the number of hits will be small because the search can find few records in the database that match the search profile entered. One reason you may end with a large number of hits is that vendors want you to see their entries even if they aren't of direct value to you. Therefore, the product description they put in the database is often overly generalized. Another reason this happens is because database suppliers want to have as many entries as possible, so they pay little attention to the package's quality or even its existence (apart from an announcement).

Despite these drawbacks, I recommend the following three databases that may be of help to you in your search for scientific software. These are available through the Knowledge Index service of Dialog Information Services, 3460 Hillview Avenue, Palo Alto, CA 94304. There are also agents in other countries around the world. The service rates for these databases (at the time of this writing) are $35 initial fee for manuals and two hours of on-line use, and $24 per hour of on-line use thereafter. (Note that there are other database services that may provide these files.)

• Menu—International Software Database (produced by Imprint Software Ltd.)

• Microcomputer Index—(produced by Microcomputer Information Services, 1982)

• Mathfile—(produced by the American Mathematical Society). The first two of these files focus on mini- and microcomputer software offerings, while Mathfile contains abstracts to the mathematical, statistical, and computing literature, including application areas, and covers approximately 1600 journals.

PUBLICATIONS

The following is a list of periodicals, catalogs, and reports that often discuss scientific software packages. Some of these sources are devoted to particular subject areas. This is not a complete list; there are other sources that offer reviews of interesting software. To obtain more information on these publications, contact the addresses provided.

• *ACM Transactions on Mathematical Software*. Although this periodical is mainly devoted to mainframes, some of the material may be suitable to microcomputers. Contact the Association for Computing Machinery, 1133 Avenue of the Americas, New York, NY 10036.

• *Advances in Engineering Software*. Some articles include program code. Microcomputers are increasingly being featured in this magazine. Contact CML Publications, 125 High St., Southampton SO1 OAA, England.

• *American Statistician*. This magazine includes announcements of statistical software. It also has a regular statistical software review section. The emphasis is on microcomputer software. Contact the American Statistical Association, 806 15th St. NW, Washington, DC 20005.

• *AMSTAT News*. This magazine is mainly of value for its advertisements, which are directed at professional statisticians. It often lists workshops and meetings where software is to be discussed. Contact the American Statistical Association, 806 15th St. NW, Washington, DC 20005.

• BYTE: *The Small Systems Journal*. This magazine provides monthly software reviews. Contact BYTE, 70 Main St., Peterborough, NH 03458.

• *The College Mathematics Journal*. This journal has a regular software review column. Contact the Mathematical Association of America, 1529 18th St. NW, Washington, DC 20036.

• *Computer Physics Communications*. Includes a section on software but mainly is of use to mainframe users. Contact North-Holland Publishing Company, Box 211, 1000 AE Amsterdam, Netherlands.

• *Computers & Chemistry*. Includes a regular section on software and the Quantum Chemistry Program Exchange. Contact Pergamon Press Inc., Maxwell House, Fairview Park, Elmsford, NY 10523.

• *Computers & Geosciences*. Some programs included, many of which are designed for, or could be adapted to, microcomputers. Contact Pergamon Press Inc., Maxwell House, Fairview Park, Elmsford, NY 10523.

• *Computers & Structures*. Discusses structural engineering methods. A software survey section is being introduced. Contact Pergamon Press Inc., Maxwell House, Fairview Park, Elmsford, NY 10523.

• *Computers in Mechanical Engineering*. The January 1985 issue is devoted to microcomputer software for analysis and design. Other issues have included similar material. Contact the American Society of Mechanical Engineers, 345 East 47th St., New York, NY 10017.

• *Econometrica*. Occasional discussion of microcomputer software. Contact Econometric Society, c/o Department of Economics, Northwestern University, Evanston, IL 60201.

• "Guide to Available Mathematical Software," *National Bureau of Standards Report NBSIR 84-2824 (1984)*. Boisvert, R. F., S. E. Howe, and D. K. Kahaner. Contact National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Rd., Springfield, VA 22161.

• *IEEE Micro*. Includes announcements of microcomputer software. Contact *IEEE Micro*, 10662 Los Vasqueros Circle, Long Beach, CA 90720.

• *Journal of Computational Chemistry*. Surprisingly little discussion of software. Contact Wiley/Interscience Scientific Journals, 605 Third Ave., New York, NY 10158.

SCIENTIFIC SOFTWARE

- *Journal of Computational Physics.* Covers only a few software packages and has a mainframe bias. Contact Academic Press Inc., 111 Fifth Ave., New York, NY 10003.

- *Journal of Forecasting.* Occasional discussion of software, including that for microcomputers. Contact John Wiley and Sons, 605 Third Ave., New York, NY 10158.

- *Journal of Microcomputer Applications.* Interesting material with some scientific applications, e.g., medicine and astronomy, but little direct treatment of software. Contact Academic Press Inc., 111 Fifth Ave., New York, NY 10003.

- *Physics Education.* Includes software reviews, mainly for microcomputer programs. Contact the Institute of Physics, Techno House, Redcliffe Way, Bristol BS1 6NX, England.

- *Science and Engineering* (1984 software catalog). Short listings on over 4300 programs, mostly for microcomputers, indexed by subject and applications. Contact Elsevier Science Publishing Company, 52 Vanderbilt Ave., New York, NY 10017.

- "Scientific Word Processing," *SIAM News.* Wong, P. K. November 1984, page 8. A review of several packages from a mathematician's perspective in the newspaper of the Society for Industrial and Applied Mathematics (SIAM). Related articles frequently appear. Contact SIAM, 1405 Architects Building, 117 South 17th St., Philadelphia, PA 19103.

- *Simulation.* Technical journal of the Society for Computer Simulation. Simulation Councils Inc., POB 228, La Jolla, CA 92038. Periodically includes a software catalog that has a specific section for microcomputers.

- *1984 Guidebook to Statistical Analysis and Graphics Software for Microcomputers.* Goss, T. I. One of the more useful directories in the statistics subject area. Available from Goss, Gilroy and Associates, 124 O'Connor St., Ottawa, Ontario, Canada K1P 5M9.

mentation of work in a number of fields, such as a word-processing system for mathematical or scientific systems or a statistical package.

Alternatively, the package may have been designed primarily to educate users in a certain subject area rather than to provide serious computational power to practitioners. An example of this kind of program is one that illustrates how simultaneous linear equations are solved or one that prepares test questions in a specific discipline from a master set.

STYLE

The way a software producer presents and packages his creation is the factor that most often causes buyers to rave or curse about software. If several software packages can perform the same function, style may become the hinge of your buying decision.

To determine if a program's style suits you, you should consider three things—the way in which the program must be used, the level of satisfaction or frustration you experience while using it, and the suitability (or fit to application) of the program's packaging and documentation.

Although it is relatively easy to list the features of a software product, even extensive reviews may fail to capture the style of the product. The expanding availability of demonstration disks (especially those that allow you to try all of a program's functions) is to be welcomed as an aid to software selection.

The three subdivisions of software I described earlier—software designed to perform certain tasks, to be used as a tool, or to be used as a teaching aid—can also be applied to the discussion of style.

Early scientific software took the form of single programs or subroutines (tasks) (for example, the collected algorithms of the Association for Computing Machinery). Libraries of subroutines are still a common and useful form of software packaging. However, unless source code is available, this form of packaging requires that you write driver programs and

(continued)

SOFTWARE TOOLS FOR SCIENTIFIC COMPUTATIONS

There are a number of software products that attempt to cover most aspects of scientific computation. Others provide a toolbox for a given area of application. Jack Dongarra looked at some of these and provided much of the information below.

GENERAL SCIENTIFIC SOFTWARE COLLECTIONS

• MATH/LIBRARY
$440; $320 for universities

This selection, which is from the well-known IMSL subroutine library, is for use on an IBM PC or PC XT with Microsoft FORTRAN 3.2 under MS-DOS 2.0. It contains 540 mathematical subroutines to solve for differential equations and integration, eigensystem analysis, error functions, gamma functions, interpolation, approximation, smoothing, linear algebraic equations, nonlinear equations, optimization, and vector/matrix arithmetic and sorting. Both single- and double-precision versions of the routines are available. Contact IMSL Inc., 7500 Bellaire Blvd., NBC Building, Houston, TX 77036-5085.

• microSUB:MATH $250

This program consists of a set of FORTRAN subroutines in relocatable-object form. The subroutines cover special math functions, interpolation, integration, matrix/linear systems, polynomials/nonlinear systems, and differential equations. Contact Foehn Consulting, POB 5123, Klamath Falls, OR 97601.

• NAG FORTRAN PC50 Library
$345; 20 percent off for universities

This package consists of 50 routines from the NAG FORTRAN library. It can be run on the IBM PC with Microsoft FORTRAN 3.13 under MS-DOS 1.0 (or later) and on the IBM PC XT with Microsoft FORTRAN 3.2 under MS-DOS 2.0. The routines cover a wide range of subjects in numerical and statistical computing, including root finding, Fourier transforms, quadrature, ordinary differential equations, optimization, linear algebra, basic statistics, random numbers, linear programming, and special functions. Contact Numerical Algorithms Group Inc., 1011 31st St., Suite 100, Downers Grove, IL 60515.

• The Scientific Desk
One-time fee of $480; maintenance fee $84 per year

This library of subroutines can be called by a user and embedded in his or her program. The package has a set of applications program menus called Problem Solving Environments (PSEs). The PSEs provide the user with a set of commands that are familiar to the subarea and can be used without programming. They provide programs in the following areas: simultaneous linear-equation solving, vector/matrix arithmetic, inversion, matrix-condition estimation, and statistical inference and estimation. They can handle real matrices stored in two-dimensional form, calculate the roots of polynomials, eigenvalues, and eigenvectors for real square matrices. Contact C. Abaci Inc., 208 St. Mary's St., Raleigh, NC 27605.

SOFTWARE FOR LINEAR ALGEBRA

• LEQB05 . . . . $50

This small linear-algebra algorithm package (of BASIC source code) consists of a number of subroutines and three driver programs that, on most computer systems, can be loaded simultaneously. The programs solve the following types of equations: linear least-squares problems, linear equations problems, matrix inverse, Moore-Penrose generalized matrix inverse, matrix eigenvalue problems for symmetric matrices, and nonlinear least-squares problems. Contact C. Abaci Inc., 208 St. Mary's St., Raleigh, NC 27605.

• LINPACK $75

This collection of FORTRAN subroutines analyzes and solves linear equations and linear least-squares problems. The package solves linear systems whose matrices are general, banded, symmetric indefinite, symmetric positive definite, triangular, and tridiagonal square. The routines are available in single-precision, double-precision, complex, and double-precision complex. Contact IMSL Inc., 7500 Bellaire Blvd., NBC Building, Houston, TX 77036-5085.

• PC-MATLAB $695

This highly optimized second-generation MATLAB for the IBM PC has been completely rewritten in the C language. New features of the program include graphics, user-defined functions, IEEE arithmetic, test data types, fast-compiled FOR and WHILE loops, and many new analytical commands. The program is available from The Math Works Inc., 124 Foxwood Rd., Portola Valley, CA 94025.

SOFTWARE FOR NONLINEAR EQUATIONS

• SEQS (The Simultaneous Equation Solver) $100

This program handles up to 20 equations with 20 variables; it is made for the Apple II+ and IIe. Contact CET Research Group Ltd., POB 2029, Norman, OK 73069.

• TK!Solver $299

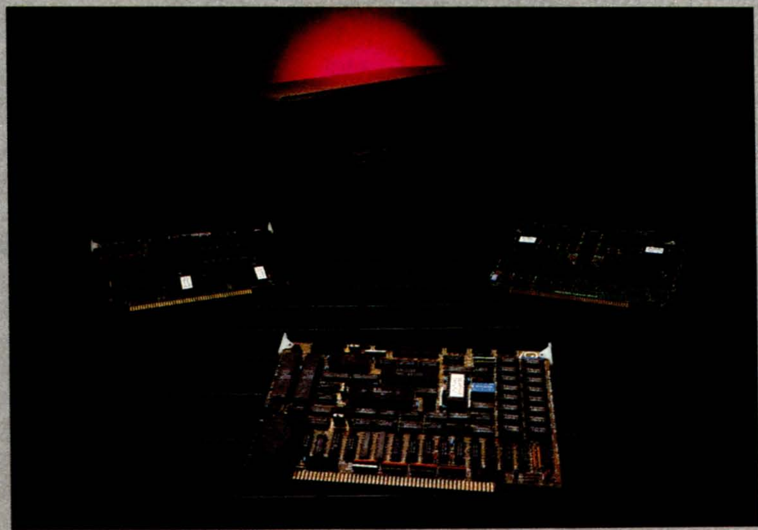
This program also solves equations, but it provides a worksheet-like user interface. For more information, see "TK!Solver" by Alan R. Miller, December 1984 BYTE, page 263. Contact Software Arts Inc., 27 Mica Lane, Wellesley, MA 02181.

SOFTWARE FOR MATHEMATICAL PROGRAMMING

• LIPS $80
• LPSUBS $99

These two products consists of FORTRAN subprograms for Large-Integer Programming (LIPS) and Linear Programming (LPSUBS) problems on the IBM PC. It is available from Software Designs 2000, POB 13238, Albuquerque, NM 87192.

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For your own protection, you should be aware of the quality of a scientific program before you buy it.

learn how to link to the compiled subroutines.

More recently, the microcomputer has come to be viewed as a workstation, which in turn has led to the development of more scientific software in the form of command- or menu-driven packages (tools) that do not require that you program them. As the command set becomes richer, you are given more control over data manipulation, and you can group commands into procedures that are interpreted, compiled, or otherwise processed for execution. The end product is a new programming language in all but name.

Another approach some software developers take is to provide a prototype program that is designed to be easily modified by the user (the teaching aid approach). You can adapt it to particular tasks or personal preferences. This approach is not widely used commercially, partly because there are difficulties in protecting the authorship of programs.

QUALITY

The degree to which software performs as claimed is far too often taken for granted.

In scientific computations, subtle interactions between the problem presented and the floating-point arithmetic used to solve the problem may dramatically alter the results a program obtains. Thus, scientific software must operate correctly on the tasks it shares with such programs as word processors or database managers. However, it must also be produced in such a way that the approximations and iterative processes it uses give results that well-informed users consider reasonable. Alternatively, diagnostic information that allows troublesome situations to be understood and corrected in an appropriate way must be output.

For your protection, you should be aware of a program's quality before you buy it. This means you should pay attention to reviews by competent professionals in the field, the documentation of authorship, methods of program development, the history of the software, and the reputation of the software producer and vendor.

CONCLUSION

The text boxes "Software Tools for Scientific Computations" on page 148 and "Microcomputer Software for Econometric Modeling and Forecasting" at left list a number of scientific software packages. However, with the development of new products and the improvement of existing ones, this information will soon be dated. In order to obtain more up-to-date information, you should also consider the following sources: reviews in scientific journals, reviews in computer journals and magazines, publications dedicated to scientific software and its uses, and public-access software databases. ■

MICROCOMPUTER SOFTWARE FOR ECONOMETRIC MODELING AND FORECASTING

This list illustrates the variety of software that may be available for a given subject area.

• ESP (The Econometric Software Package) $795

This package uses menus, function keys, and commands to build a specialized language for estimation, forecasting, simulation, and analysis. Contact Alpha Software Corporation, 30 B St., Burlington, MA 01803

• Horizon/370 Software for the AT/370 One-time fee of $50,000; maintenance fee is $5000 per year

This forecasting workstation incorporates econometric forecasting and time-series techniques. Contact Chase Decision Systems, 1000 Massachusetts Ave., Cambridge, MA 02138.

• INSTAT—QF $19.95

The QF stands for "quick forecaster." This program is for the IBM PC or PC XT. It uses ARIMA modeling and is menu-driven. The price of both programs is more than reasonable. Contact Statistical Consulting Services, 517 East Lodge Dr., Tempe, AZ 85283.

• MICROBJ $295

This ARIMA system is based on the Box-Jenkins philosophy. It is for the Apple II or IBM PC. Contact Stratix, POB 1014, Woodinville, WA 98072-1014.

• Nuametrics $195

This econometrics package uses single- and multiple-regression techniques for statistical analysis and forecasting. Contact Stratix, POB 1014, Woodinville, WA 98072-1014.

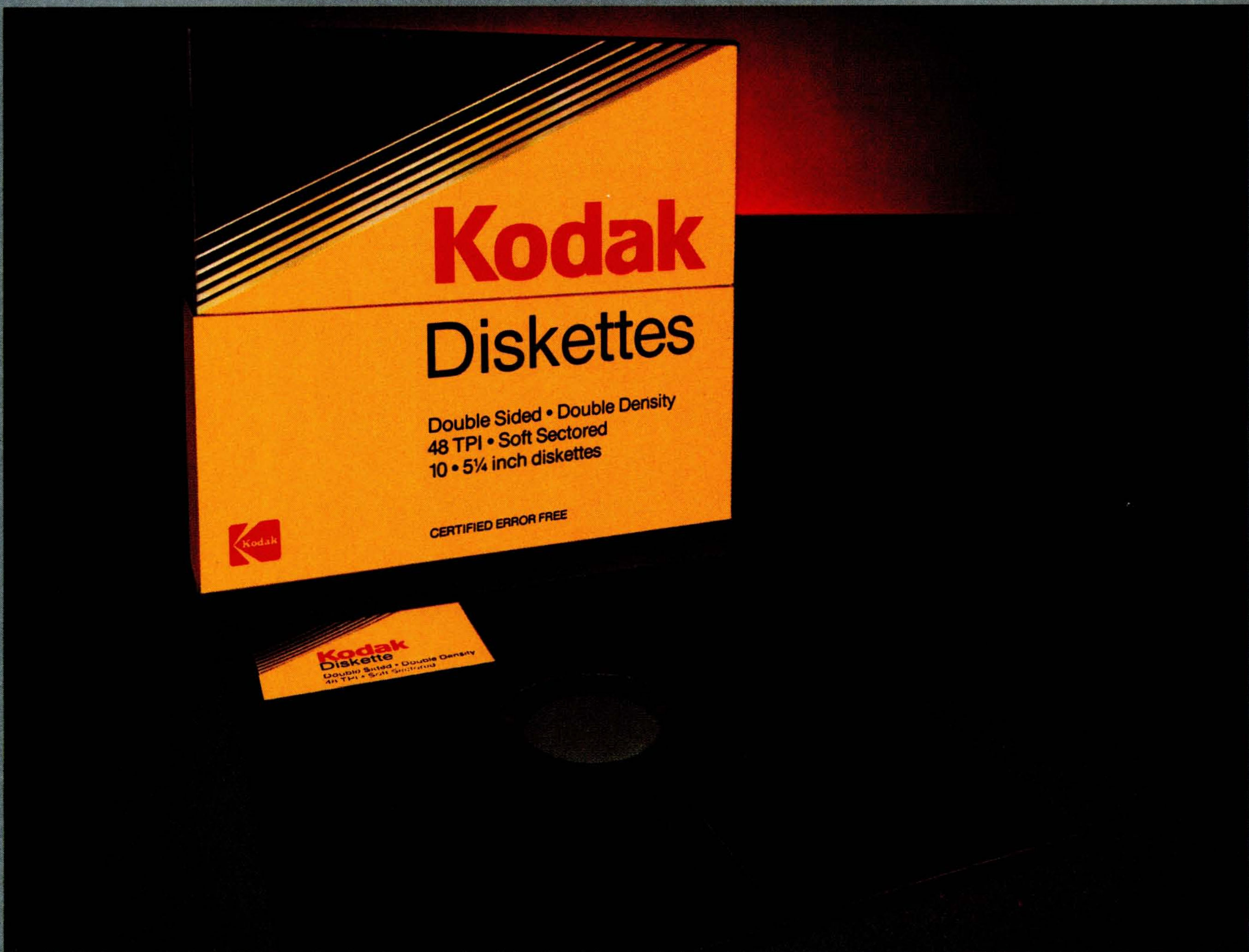
• RATS (Regression Analysis of Time Series) $250

This is a comprehensive command-driven system for knowledgeable users of the IBM PC. The summary listing of commands is 12 pages long, so it's not a product you can just switch on and use. A hard disk is not mandatory, but it helps. The program is available from VAR Econometrics, 134 Prospect Ave. S, Minneapolis, MN 55419.

• XTRAPOLATOR $195

This is an automatic forecasting system. Contact Stratix, POB 1014, Woodinville, WA 98072-1014.

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You'll find Kodak diskettes at computer stores, office supply dealers, and other retail outlets. In standard-density 8- and 5¼-inch formats, plus high-density 5¼-inch diskettes, and 3½-inch micro diskettes.

The Kodak diskettes. Performance without the fine print.



KODAK.
The name says it all.


AT

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Presenting the COMPAQ DESKPRO 286.™ More features, more speed...more power.

Most people think the IBM® Personal Computer-AT™ holds the records for speed, memory, and storage. But COMPAQ® has a personal computer that pushes the technology much further.

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Most computer companies would have been satisfied with a computer that ran programs as fast as the IBM PC-AT. But not COMPAQ. The COMPAQ DESKPRO 286 runs all the popular programs 30% *faster.*

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In short, with the COMPAQ DESKPRO 286, you don't get compromises. Just a more powerful, more advanced, more complete personal computer for anyone who demands the utmost in performance.

And if you need all this power to go, we also offer it in a package half the size of an IBM PC-AT, complete with a handle. It's called the COMPAQ PORTABLE 286™.

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It simply works better.

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IBM/PC-based LOGIC LINE-1™ artificial intelligence software is so advanced, that competitive products are toys by comparison.

There aren't very many who'd stake their lives on a toy-store pacemaker. Luckily, we won't have to worry about their rancid cells polluting mankind's gene pool very long anyhow. Such brain-damaged geeks tend to die young.

If you've recently spent money on artificial intelligence software, you might be wishing a few programmers had croaked before writing that blithering swill they named AI and palmed off onto you. What they call an "inference engine" is nothing more than an IF-THEN decision tree that can't even do a very good job of arithmetic*

We're Clarity Software, and we're introducing a product that can take a massive amount of text from any machine-readable source, and mathematically distill thought processes for query and analysis. This process, as distinguished from *expert systems*, is referred to as *natural-language intelligence*.

In this ad, we're going to explain to you why you'd be crazy not to have our package in your portfolio of data-manipulation assets.

DERIVE THE DNA/RNA OF ANY WRITER'S THOUGHT PROCESSES.

LOGIC LINE-1 was the result of the interaction between a couple of cyberneticists and a physicist, with combined experience in high-performance learning and pattern-recognition programming. The physicist was responsible for one of the first DNA/RNA-tracking systems (the *RNA-of-thought* assertion is more than just an advertising creation). We are not your ordinary bunch of yahoos.

Imagine having the collected thoughts of Voltaire online. If you were interested in viewing Voltaire's thoughts on "job security," you would enter that term in the search menu.

Now you're thinking: "Nuts! These yahoos are trying to sell me something my supposedly *toy* text editor can do with a search command. Right?"

Wrong, pussycat. Your inference process was a little quick on the trigger. Never, in any of Voltaire's writing, was there ever the phrase "job security."

"Ok," you reply. "You have a dictionary of synonyms, eh?" Wrong again. LOGIC LINE-1 has no dictionary. Interesting?

Essentially, LOGIC LINE-1 uses a series of mathematical transformations on text, the output of which is cataloged in a database analogous to a biological DNA/RNA imprint of that text.

There are approximately one dozen parameters that make up a *thought's DNA/RNA*. Some transformations fingerprint syntax patterns; some look at subject/predicate relationships via a small dictionary of several dozen *noise* words.

After setting up the above Voltaire "job security" query, LOGIC LINE-1 will present you with high-possibility "hits." You will type "Y" when they are relevant, and "S" for skip, when they are not.

The first several "hits" might be rejected, since the term "job security" will not be found. Once you get an acceptable entry, however, and lock onto an acceptable *RNA-of-thought* pattern, the accuracy of LOGIC LINE-1 will be staggering. Or we'll refund your money. Simple enough?

"I'M NOT INTO VOLTAIRE," YOU SAY. "WHY DO I NEED LOGIC LINE-1?"

How would you like to be able to turn any textbase into an expert system? For example, most PC users rely upon word processing. The problem is, we store our correspondence in files with names like "LT062185" or "REJECT21" or "RANDOMTH." As a result, we reinvent the wheel with each letter we compose. Why do this?

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Thus, when writing letters and speeches, use LOGIC LINE-1 to collect previously articulated thoughts on any given subject. Whatever your profession, be it law, medicine, engineering or information management, LOGIC LINE-1 is an indispensable tool for true thought processing.

Now that thousands of textbases are publicly available, LOGIC LINE-1 is the key to their intelligent use. Once the computer establishes associative links in a large body of material, many creative applications are possible.

TRUE AI! CLONE THE GREAT MINDS ON YOUR PC.

Did Bacon write Shakespeare? Did Albert Einstein have anything relevant to say on the subject of "generation gap?" How many congressmen consistently contradict themselves in the *Congressional Record?*

The uses of LOGIC LINE-1 are limited only by the availability of textbases, and by your imagination.

Do you dare send a student to college without LOGIC LINE-1 and a PC? Would YOU care to compete in business with someone else who has this leading-edge, decision-support software?

Einstein should write your papers on relativity. Alfred North Whitehead should write your papers on philosophy. And Shakespeare should write your love letters.

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This is our very first, and only, announcement ad. For the rest of this year, you may obtain LOGIC LINE-1 for only $100 (note, we didn't try to fool you with a $99.95 price tag; we *do* give you, as well as your computer, some credit for intelligence). As of January 1, 1986, LOGIC LINE-1 will retail for $250.

To find out more about LOGIC LINE-1, call 216/729-1132. You may order by phone by calling 800/621-5839 (or in Illinois, call 800/972-5855). Return the product for any reason whatsoever within 30 days for a full refund. If you are with the US government or one of the intelligence *spook shops*, LOGIC LINE-1 is available to federal/DOD buyers through IBIS Corporation, 131 Elden Street, Herndon, VA 22070 (call 800/532-3344 or 703/478-0300).

You COULD spend your next $100 for other software. You could also ask Weird Al Yankovic to install that terrific new pacemaker from your kids' *Young Doctor* toy kit. Call today and save more than just money.

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*The only other package out there worthy of the label "artificial intelligence" is from Teknowledge in Palo Alto, and we don't compete with them. They build "expert systems," while our emphasis is on "natural language" systems. We mention them in passing, because they're one of the few "good guys." and requires a 128K IBM PC with at least one diskette drive and runs under MS/DOS 2.1 and up. IBM™ IBM Corp. MATTEL™ Mattel. We hope the swell people at Mattel can take a joke. Advertising & PR by TRBA, 408/258-2708.

Inquiry 60

VIRTUAL FIELDING IN MICROSOFT BASIC

BY C. R. J. CURRIE

A method for handling files with large record lengths

THIS ARTICLE DESCRIBES a technique for handling files with record lengths exceeding a sector on Microsoft BASIC (MBASIC) systems. I originally devised this technique for use on Tandy's TRS-80 Models I, II, and III, which have sector lengths and maximum record lengths of 256 bytes, but it should be usable with little or no change on most versions of MBASIC. Your version of BASIC should be able to automatically handle variable-length records of a size less than the system's maximum.

On the TRS-80s and other systems with short maximum record lengths, the usual method for handling long logical records is called span blocking. Fields of the records are written to disk one by one. Before each is written, the position of the start of the field within the physical sector is calculated. If the field will then overflow the sector, the extent of the overflow must be determined, the field split into two, and the remainder written to the next sector. The calculations are then repeated for each successive field. The procedure is slow and cumbersome.

In more advanced versions of MBASIC, including those running on machines that use the Intel 8086 microprocessor or its derivatives, there is automatic span blocking; logical record lengths up to 32K bytes can be handled directly. Nevertheless, you will encounter two serious difficulties when you manage such long records. First, the FIELD statement can only cope with buffers up to approximately 7K bytes. Second, MBASIC allows the program to address only 64K bytes of memory (one segment if the 8086 is used). You must reserve file buffers before entering BASIC, and the space they use is deducted from the memory available for programs and data. Moreover, the space you reserve for every buffer must equal that needed for the largest file buffer. Thus, if you need to handle a large data file with 20K-byte records, using two other index files each with a much smaller record length, you still must reserve 60K bytes, which leaves hardly any space for the program. In some cases, where the total space used by the file buffers exceeds 64K bytes, the system will appear to leave more memory—but that is deceptive and potentially disastrous, since some of the file buffers may in fact be mapped onto the program area. Therefore, the very large file buffers that the system seems to permit are virtually useless.

By contrast, the "virtual-fielding" method, which uses a virtual-memory technique to control the buffers, allows you to handle up to 15 files simultaneously, with combined record lengths of 300K bytes on the 48K-byte TRS-80 (or half a megabyte or more on a 128K-byte machine running MBASIC-86). The virtual-fielding method requires no span blocking and does most of the few needed calculations only once at the beginning of the program. Moreover, you can treat each long record (for purposes of data transfer, hash coding, or tree searching) as a single logical record. Compared with span blocking, there is usually a waste of some disk space, but it should never be as much as 1 percent within each logical record. Since span blocking generally wastes a little space in the last sec-

(continued)

C. R. J. *Currie* (*Institute of Historical Research, Senate House, Malet Street, London WC1E 7HU, England*) *has been involved since 1981 with the use of microcomputers in the fields of historical research, writing, and publishing.*

tor of each file, virtually fielded files will seldom be longer than span-blocked files.

The technique requires that you reserve an area of high memory for the record buffers of long files. The area must be slightly greater than the longest record length used in the files that the program accesses, and you must protect the area when you enter BASIC from the operating system. In MBASIC, you type MBASIC /M:*nnnnn* from the operating-system prompt, where *nnnnn* is the address above which the memory is to be protected. The same area of memory will be mapped to handle all the files' logical records.

The management program must know the number of files, their record lengths, and the number and lengths of the fields in each file. For each file, an initialization routine calculates the number of 256-byte sectors required for each logical record and then calculates a standard buffer length. If the logical record length is (or is just one byte short of) a multiple of the sector length, the routine assigns a 128-byte buffer. In other cases where the record length is not an exact multiple of the sector length, the buffer length will be less than 256 bytes, and the record length will be rounded up to a multiple of the buffer length. Each buffer will be treated as a single field for interaction with the interpreter. Single-dimensioned arrays (one of integers, the other of strings) hold the file buffer lengths and the buffer field variables. The number of elements of the arrays is the number of files to be handled. A third array of dummy strings is set up at the same time; the length of each string element is set to that of the corresponding file buffer. You can then open the files with the appropriate buffer lengths.

Next, the routine sets up a two-dimensional array of strings for the logical fields. One dimension's size equals the total number of files; the other dimension's size is the largest number of fields used in any file. For each file, the routine points the appropriate strings in the array sequentially at the protected memory buffer by manipulating the array's VARPTR function. All the logical records are thus mapped onto the same area of memory, a safe process because only one file can be read from or written to at any time and because the buffer is only used for temporary storage.

When the routine writes a record, it transfers data to the fields in the memory buffer using the LSET or RSET block-move commands, just as if the fields were ordinary field variables. It then uses the appropriate dummy string as a window and steps across the memory buffer by manipulating the pointer to its address. After each step, it uses LSET to trans-

(continued)



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Listing 1: A *short demonstration program.*

```
10 REM DEMO LONG BUFFER PROGRAM FOR TWO FILES:MULTIFILE
   METHOD.
11 '    C.R.J. CURRIE. 18 DECEMBER 1984
14 '
15 REM *** CLEAR (STRING SPACE IF NEEDED), SET SAFETY MARGIN
20 ' FOR MBASIC-86, USE 600: FOR TRS-80, USE 10
24 '
25 CLEAR 5000:DEFINT F:MG=600
26 '
27 REM *** DETERMINE ADDRESS OF PROTECTED MEMORY BUFFER
28 ' LINE 30 MUST BE EXECUTED BEFORE ANY OTHER STRING WORK
29 '
30 A$=A$:HI=PEEK(VARPTR(A$)+1)+PEEK(VARPTR(A$)+2)*256:HI=HI+MG
40 REM *** FOR TRS-80 MODEL I/III USE:
41 REM *** HI=PEEK(16561)+PEEK(16562)*256:HI=HI+MG
42 '
43 REM *** MOD FUNCTION IF YOUR BASIC LACKS IT
44 '
45 DEF FNMD%(A,B%)=A-(INT(A/B%)*B%)
49 '
50 READ NF%:DIM F$(NF%):' NUMBER OF FILES
57 '
58 REM *** TEST ON TWO EXISTING FILES FOR DEMO PURPOSES
59 '
60 FOR N%=1 TO NF%:PRINT"NAME OF FILE NUMBER";N%;" ";:LINE INPUT
   F$(N%)
70 NEXT
79 '
80 GOSUB 6000: REM *** INITIALIZE BUFFERS
87 '
88 REM *** DEMO ARRAY
89 '
90 DIM B$(FO(1))
297 '
298 REM *** DEMO READ (E.G., OF EXISTING TEXT FILE)-SECOND RECORD
299 '
300 FOR M%=1 TO NF%
310 KT$=TIME$:RC=2:GOSUB 1000:GOSUB 700:FOR N%=1 TO
    FO(M%):PRINT B$(N%);:NEXT N%,M%:CLOSE:END
497 '
498 REM *** WRITE VARIABLES TO MEMORY BUFFER: DEMO ONLY
499 '
500 FOR N%=1 TO FO(M%):LSET FA$(M%,N%)=B$(N%):NEXT:RETURN
697 '
698 REM *** READ VARIABLES FROM MEMORY BUFFER:DEMO ONLY
699 '
700 FOR N%=1 TO FO(M%):B$(N%)=FA$(M%,N%):NEXT:RETURN
997 '
998 REM *** READ RECORD FROM DISK-INVARIANT; M%=FILE NUMBER,
    RC=LOGICAL RECORD NUMBER
999 '
1000 FSTART!=HI:FOR N%=1 TO NBUF%(M%)
1020 GET M%,(RC-1)*NBUF%(M%)+N%
1024 '
1025 GOSUB 23000:REM *** MOVE WINDOW THROUGH MEMORY BUFFER
1029 '
1030 LSET FC$(M%)=FB$(M%):NEXT
1050 RETURN
1997 '
1998 REM *** WRITE RECORD TO DISK-INVARIANT
1999 '
```

(continued)

fer the contents of the memory buffer to the file buffer and that buffer is written to disk. A loop handles these operations easily. To read a record, the routine reverses the procedure. To ensure that the logical field strings keep pointing at their correct places in the memory buffer, you need only avoid using them on the left side of an assignment statement other than MID$, LSET, or RSET.

The sum of the longest record length and the space occupied by the 3-byte string pointers of the logical field array determines the maximum number of files and fields and the size of record. A 15-row by 100-column string array uses less than 5K bytes for pointers. With 255-byte logical fields, that would allow each record of each of the 15 possible files to have up to 25,500 bytes, or a total of 382,500 bytes, at a sacrifice of only 30K bytes of RAM (random-access read/write memory). In 16-bit MBASIC, that still leaves 32K bytes for the program and space in which to manipulate the data.

A demonstration program (see listing 1) reads data from two files whose record lengths are 1066 bytes and 701 bytes. The program assumes a default record length of 256 bytes; in some versions of MBASIC, you must specify this default when you load BASIC. The demonstration files use all string fields, but the method is equally applicable to MBASIC's compressed numeric fields. You can use existing text files to test the program.

DATA statements at the end of the program store the number of files, and for each file the record length and the number and length of fields. For files with very long record lengths, however, it would be more appropriate to store that information in a separate sequential file and read it in at the beginning of the run, replacing all READ statements by INPUT# statements. Note that the data for the file with the most fields must head the list. Line 45 defines a modulo function; it is not needed for MBASIC versions that have a MOD function. For

(continued)


GP TOOLS
•GP FILE
•GP PRINT
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```
2000 FSTART! = HI:FOR N% = 1 TO NBUF%(M%):GOSUB 23000:LSET
     FB$(M%) = FC$(M%)
2010 PUT M%,(RC - 1)*NBUF%(M%) + N%:NEXT
2020 RETURN
5997 '
5998 REM *** BUFFER INITIALIZATION ROUTINE: INVARIANT
5999 '
6000 DIM BU%(NF%),FC$(NF%),FB$(NF%),NBUF%(NF%),FO(NF%)
6010 FOR M% = 1 TO NF%:GOSUB 6020:NEXT M%:RETURN
6017 '
6018 REM *** CALCULATE BUFFER LENGTHS FOR EACH FILE
6019 '
6020 FSTART! = HI
6030 READ RL:REM *** RECORD LENGTH
6040 READ FO(M%):REM *** NUMBER OF LOGICAL FIELDS
6050 IF M% = 1 THEN DIM FA$(NF%,FO(1)):' ARRAY FOR FIELDS
6060 NBUF%(M%) = INT(RL/256):IF FNMD%(RL,256) = 255 THEN
     RL = RL + 1:GOTO 6060
6070 IF FNMD%(RL,256) = 0 THEN
     NBUF%(M%) = NBUF%(M%)*2:BU%(M%) = 128:GOSUB 20015 ELSE GOSUB
     20000:REM *** FIELD FILE BUFFER AND DUPLICATE BUFFERS
6097 '
6098 REM *** NOW FIELD LOGICAL FIELDS
6099 '
6100 FSTART! = HI
6110 FOR N% = 1 TO FO(M%):READ A%:TP = VARPTR(FA$(M%,N%)):POKE
     TP,A%:GOSUB 25000:FSTART! = FSTART! + A%
6120 NEXT N%
6130 RETURN
19997 '
19998 REM *** FILE BUFFERS FOR IRREGULAR RECORD LENGTH
19999 '
20000 NBUF%(M%) = NBUF%(M%) + 1:BU%(M%) = INT(RL/NBUF%(M%))
20010 IF FNMD%(RL,NBUF%(M%)) < > 0 THEN BU%(M%) = BU%(M%) + 1
20015 FC$(M%) = FC$(M%):GOSUB 22000:RETURN
21997 '
21998 REM *** OPEN FILES
21999 '
22000 OPEN"R",M%,F$(M%),BU%(M%)
22010 FIELD M%,(BU%(M%)) AS FB$(M%)
22020 RETURN
23000 TP = VARPTR(FC$(M%)):POKE TP,BU%(M%)
23010 GOSUB 25000
23020 FSTART! = FSTART! + BU%(M%): RETURN
24997 '
24998 REM *** POINT STRING AT MEMORY BUFFER
24999 '
25000 POKE TP + 1,FNMD%(FSTART!,256):POKE
      TP + 2,INT(FSTART!/256):RETURN
29997 '
29998 REM *** DEMO DATA:CHANGE AS APPROPRIATE
29999 '
30000 DATA 2:REM *** NUMBER OF FILES
30005 DATA 1066:REM *** RECORD LENGTH OF FIRST FILE
30010 DATA 6:REM *** NUMBER OF LOGICAL FIELDS
30020 DATA 101,151,202,203,204,205:'LOGICAL FIELD LENGTHS
30030 DATA 701:REM *** RECORD LENGTH OF SECOND FILE
30035 DATA 4:REM *** NUMBER OF LOGICAL FIELDS, FILE 2
30040 DATA 200,200,200,101:'FIELD LENGTHS FOR FILE 2
```

those versions, you can replace calls of the form **X%= FNMOD%(A,B%)** with **X%=A MOD B%**.

The program begins by calculating the address of the bottom of protected memory (line 30), allowing a safety margin (MG) above the top of BASIC's string space (which you must adjust for your version of MBASIC). The program then reads the number of files and sets up an array of filenames that it reads from the keyboard. Line 6000 begins the main initialization routine, which is invariant in form for all virtual-fielding applications. The initialization sets up the arrays for buffer lengths (BU%), dummy string windows (FC$), file buffers (FB$), buffer numbers (NBUF%), and numbers of fields (FO). A separate subroutine at line 6020 calculates the number of sectors needed for the logical record of each file. If required, that separate subroutine calls the routine that computes irregular buffer lengths (beginning at line 20000) and then calls the file-opening routine at line 22000. The program can later call the file-opening routine if any file has been closed in the meantime, after setting **M%** equal to the number of the closed file. Lines 6100–6130 set up the logical fields (FA$).

Lines 500 and 700 provide two straightforward demonstration subroutines for transferring data to and from the logical record buffers; only the read routine is used here. The routines for reading and writing a record to disk are at lines 1000–1050 and 2000–2020. Like the initialization routine, they are invariant for all virtual-fielding applications. Both call a subroutine at 23000, which steps the **FC$** dummy string through the memory buffer by altering its address.

Virtual fielding should remain useful in the future because the technique works well under both 8-bit and the current 16-bit versions of Microsoft BASIC. Today we have more advanced 16-bit versions of Microsoft BASIC that allow for 64K-byte strings and a megabyte or more of address space, and we have computers using optical storage media with capacities of hundreds of megabytes. ■

READ ONLY



A review of the IBM Personal Computer Family. Vol. 2, No. 3



HARDWARE NEWS

A growing family of PC Printers.

Different jobs demand different printers. IBM has developed a full line of printers for its Personal Computer Family to answer those demands. Two of the most recent—the IBM Proprinter and the IBM Color Jetprinter—deserve special mention.

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The IBM Proprinter.

The IBM Proprinter alone can help you complete a variety of different home or office jobs.

It has an unusual feature that will be welcomed by everyone who has spent time switching back and forth from single-sheet to continuous forms printing. A special slot in the front of the Proprinter allows you to print single pages or envelopes quickly and easily without removing the continuous forms paper.

The Proprinter's high-speed (200 cps), dot-matrix technology can make short work of your day-to-day printing tasks like first drafts of letters or reports.

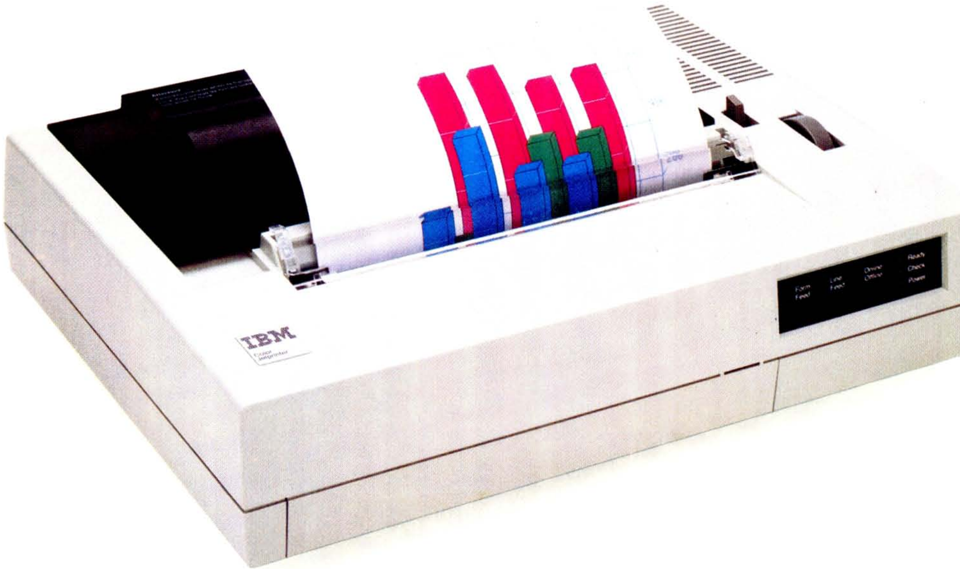
For more finished work, the Proprinter does near-letter-quality printing (at 40 cps) and lets you add emphasis to your text (at 100 cps) with bold print, condensed print and underlining.

It also has all-points-addressable graphics capabilities that can help you produce a complete range of charts and graphs to illustrate your text.

One additional plus: it's very competitively priced.



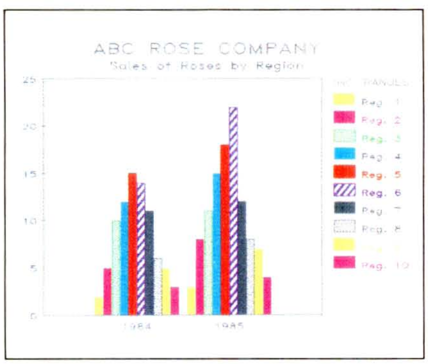
IBM Proprinter has a convenient slot for printing envelopes or single pages.

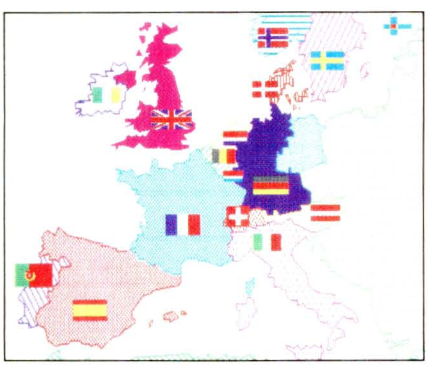


IBM Color Jetprinter quietly utilizes "drop-on-demand" ink jet technology.

The IBM Color Jetprinter.

The IBM Color Jetprinter is an unusually quiet, compact workstation printer that utilizes advanced "drop-on-demand" ink jet technology.





Samples of color graphics and texts produced by IBM Color Jetprinter.

Designed to be used with the IBM PC and many other personal computers, it's supported by a wide selection of software programs.

You can use it to produce draft and near-letter-quality text and high-quality graphics in up to seven colors.

In addition, the Jetprinter allows you to highlight your text with bold and underlined passages done in color or printed against a background color.

The Color Jetprinter also prints graphs, charts, engineering drawings and texts directly onto special Jetprinter transparencies for presentations.

And, thanks to a unique non-clogging ink formula, it performs all these functions very reliably.



FAMILY TIES

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With only a few simple commands, you can use your IBM PC to receive, display, store and replay the data you choose in high-resolution color graphics and texts.

And if you need more than information retrieval, PC Videotex, in certain configurations, can be used to support your own Videotex data base.

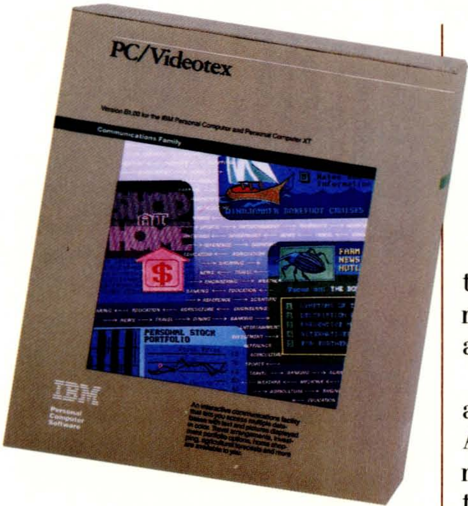


WHAT'S THE PROGRAM?

Create your own presentations.

Everyone who has ever put together a visual presentation for a business meeting or other educational purpose can now take heart. With the help of IBM PC Storyboard software, an IBM PC and a color graphics monitor you can turn out professional-looking, captivating presentations complete with color, special effects and eye-catching graphics.

PC Storyboard's four modules—Picture Taker, Picture Maker, Story Editor and Story Teller—make it fast, easy and comparatively inexpensive to create, combine and modify pictures and stories. There's even an animation function that makes it possible for birds to fly, ships to move across water, words to become bigger.



IBM PC Videotex software makes Videotex connections in high-resolution color graphics and text.

Picture Taker lets you store the contents of screen displays from software you regularly work with, such as spreadsheet, business graphics, drawing or word processing programs.

You can use the Picture Maker module to edit and combine the graphics you've saved. Picture Maker also allows you to create completely new pictures containing both text—in a variety of type styles—and graphic figures.

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The finished presentation can be copied on diskettes for distribution. You can also produce printed copies with a graphics printer like the IBM Color Jetprinter reviewed in this issue of *Read Only*.

After that, all you need is a director's chair from which to view the finished product.

Expand capabilities with IBM Planning Assistant Solutions, IBM Document Retrieval Assistant and PC Storyboard software.

Information at your fingertips.

A few months ago in this space, we reviewed Office Correspondence Retrieval System (OCRS) software from IBM, which provides a convenient way to keep track of information that otherwise might be filed and never found again.

That same application is now available as a member of the IBM Assistant Series, with an easy-to-use menu system that's consistent with those found in other Assistant Series programs.

Like the original OCRS software, IBM Document Retrieval Assistant makes life much easier for anyone who stores large amounts of information on a fixed disk or who has a library of documents, memos or files stored on diskettes.

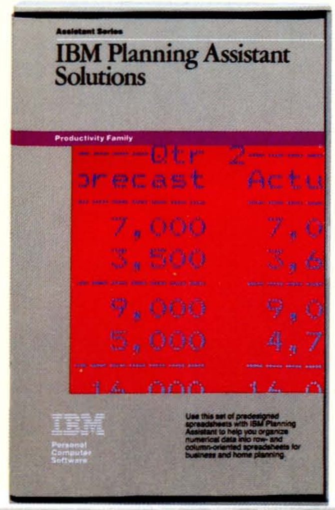
First, it automatically summarizes information and stores it for future reference. Second, and most important, Document Retrieval Assistant allows you to locate information with simple English-language queries.

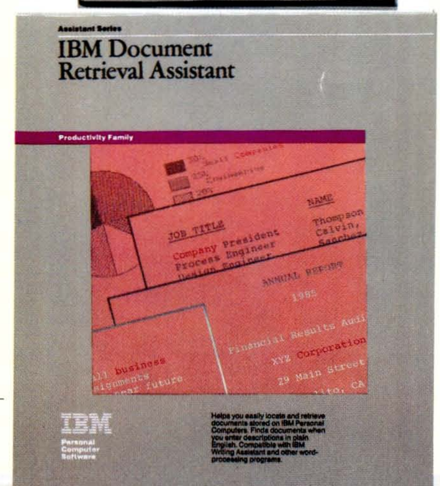
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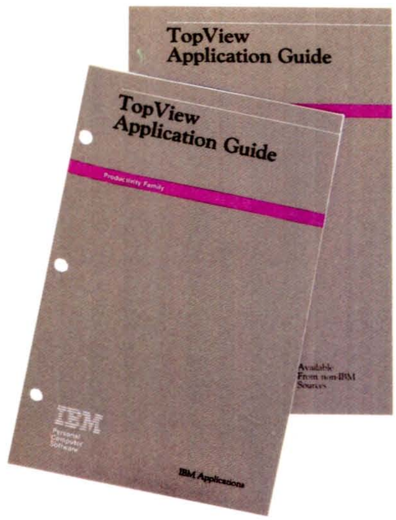


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TRAVESTY WITH DATABASE

BY NEIL J. RUBENKING

Breakdown is a fast travesty generator that stores frequency information in a database

Editor's note: Travesty generation has apparently caught the interest of BYTE *readers. The original travesty generator—a Turbo Pascal program using letter-combination frequencies to generate random text—was presented by* Hugh Kenner *and* Joseph O'Rourke *("A Travesty Generator for Micros," November* 1984 BYTE, *page* 129). *The program's execution time, however, depends on the product of the lengths of the input string (the input text file) and the output string (the desired amount of output text). Readers have been working on improving the speed and capabilities of Travesty, the original program, since then. First, we had* Murray Lesser *("Travesty Revisited," July* BYTE, *page* 163) *rewrite Travesty in Microsoft* BASIC. *Next, we had* Peter Wayner *("Build a Travesty Tree," September* BYTE, *page* 183) *use a* BASIC *program that improves execution time by storing frequency tables as data trees in memory. Now we have a different version of Travesty—Breakdown—written in Turbo Pascal by* Neil J. Rubenking. *This program improves performance and avoids rereading the input text by storing the frequency information in a database.*

I was fascinated by the original travesty-generator program, but I found the execution speed unbearably slow for large texts. Scanning the whole text for each character took too long, and the limitations of Hellbat were not acceptable to me. I developed a different version of Travesty, which I call Breakdown to distinguish it from the original program. In brief, what makes Breakdown different from Travesty is that it stores its data as a file of frequency tables with B-tree access. You don't have to read through the original text each time you want to create a travesty, and you can even read in several texts by the same author, producing a more detailed "style table."

Note that there are calls (AddRec, FindKey, GetRec, PutRec, etc.) to an optional software package—Turbo Toolbox—that may require modification for use with your particular configuration. This program may be freely copied for noncommercial use only. [*Editor's note: The source code for Breakdown and a documentation file are available for downloading via* BYTE*net Listings. The telephone number is* (617) 861-9764.]

To analyze a text, Breakdown looks at it in chunks of a particular size (one less than the "order") and keeps a record of which characters occur immediately after that pattern. If the chunk is new to the frequency table, it is added to the table. Its frequency array is initially all zeros, except for the current next character. If the chunk already exists in the table, its frequency array is incremented by one for the current next character. Then the chunk is shifted one character to the right and the process goes on—that is, the chunk's first character is dropped and the current next character is tacked onto the end.

Checking to see if the chunk is present would be a difficult task if the frequency table were stored sequentially. Fortunately, Borland International's Turbo Toolbox implements fast indexed storage using the B-tree system. The chunks of text are stored in the B-tree index file—they are the *keys*. The data file contains only the frequency arrays. Ordinarily, the keys would also be stored in the data file, but this redundancy is not strictly necessary. Since the data file can conceivably contain one record for every byte in the source, we want to keep the record size to a minimum. (This

(continued)

Neil J. Rubenking (300 *Page St., San Francisco, CA* 94102) *is a systems analyst for the Zen Center of San Francisco and is president of the San Francisco PC Users' Group.*

Breakdown lets you combine data files to make bizarre hybrids of two authors' works.

"worst case" would occur only if *no* pattern in the text occurred more than once.)

At present, Breakdown tracks 34 characters. These are the 26 lowercase alphabetic characters, along with the space, period, comma, dash, question mark, number symbol, single quote, and ASCII character 20 (the paragraph symbol). If a line is shorter than the constant LineWidth (currently set to 55), it is considered to have ended "early" with a hard carriage return and is marked with the paragraph symbol at the end. In the preprocessing phase (procedure CleanUp), all letters are converted to lowercase, all numbers are reduced to a single # symbol, double quotes become single quotes, and all unused punctuation is removed. It would, of course, be possible to track more characters, but each character adds a byte to every record.

To generate new text, Breakdown randomly selects a key that begins with a space (i.e., one that doesn't start in the middle of a word.) It then looks up the frequency array for that key and selects the next character at random from the characters with nonzero frequencies, weighted by the frequencies. This character is added to the current output line and to the current key chunk. If the paragraph symbol is encountered, the line is automatically ended. Also, the current line ends at the first space encountered after its length surpasses the LineWidth constant. The first alphabetic character after a period, question mark, or line end is capitalized.

Breakdown is a prime candidate for RAM-disk operation. The B-tree file access limits the number of disk accesses quite a bit, but there are still several accesses for each byte in the source file. The data file of a text under 10K bytes in length will definitely fit on one 360K-byte floppy disk, but an 11K-byte file could run over that length. You may distribute your files to various disk drives—a likely arrangement is .DAT file on drive B and source, .INX file, and the Breakdown program on drive A.

The higher the order, the more intelligible the output will be. However, a high order and a short text will mostly just regenerate the original. Experiment with various texts and various orders. You can use the List (L) option to see what sort of records are being generated. For a 2000-byte file using an order of 8, Breakdown takes 9 minutes to input and 7 minutes to output. Breakdown has been tried on a 100K-byte text file, with the order set to the maximum of 8. It took over 6 hours and generated a 1.8-megabyte data file, but it worked.

Breakdown will prompt you for the order each time you make a selection from the menu. After you have entered an order, you can just press the carriage return for the previous value. The filename Main works the same way—after the first time you enter it, pressing the carriage return will recall the same name. The default for the .DAT and .INX drives and the output file, if any, is the same as the source file. Thus, if you have Analyzed (A) a text with all its files on one drive, you can fill in the blanks for Generating (G) a travesty by repeatedly pressing the carriage return.

The Merge (M) option lets you combine two data files, possibly from wildly different sources. The data and index files of the "source" will be permanently changed, so you may want to keep a copy of the original files. You can also "read in" another text into an existing data file. Use this option to build up a frequency-table "model" of a particular author or to make bizarre hybrids by combining two authors' works.

Breakdown is a moderately sophisticated database program with almost no "serious" uses. However, there are all kinds of nonserious uses for it. For instance, you can read in three or four "letters from camp" and then let the computer generate more, or you can generate new speeches based on our President's proclamations, or make up your own use for this new travesty-generation technique. ■

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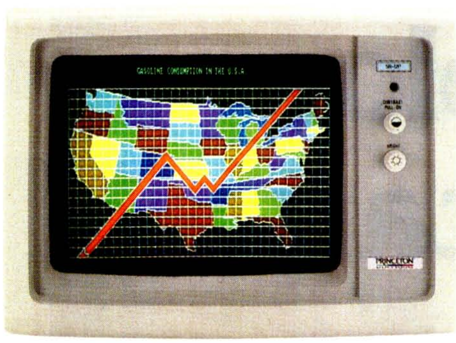
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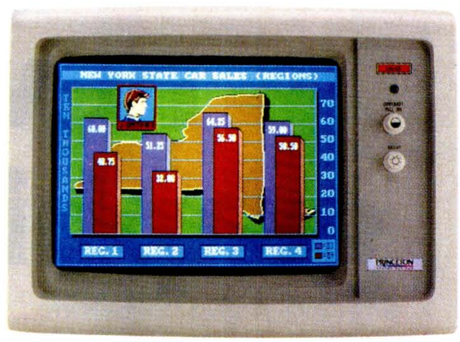


COMPARE:	Princeton SR-12P	IBM 5175
Dot pitch (The lower, the better.)	.26 mm	.31 mm
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Warranty	1 Year	90 days

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COMPARE:	Princeton HX-12E	IBM 5154
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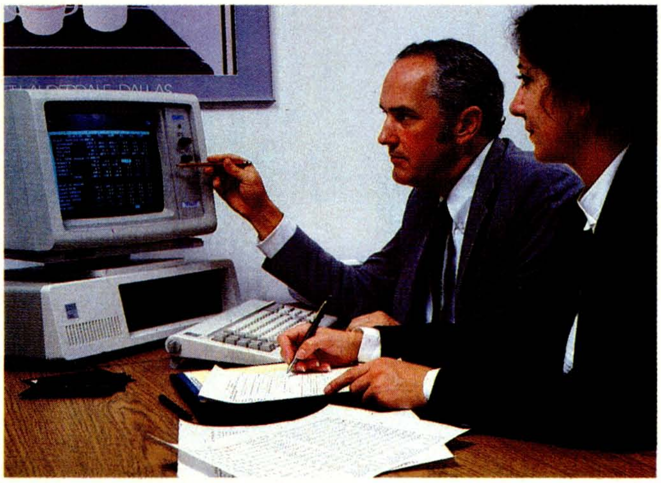
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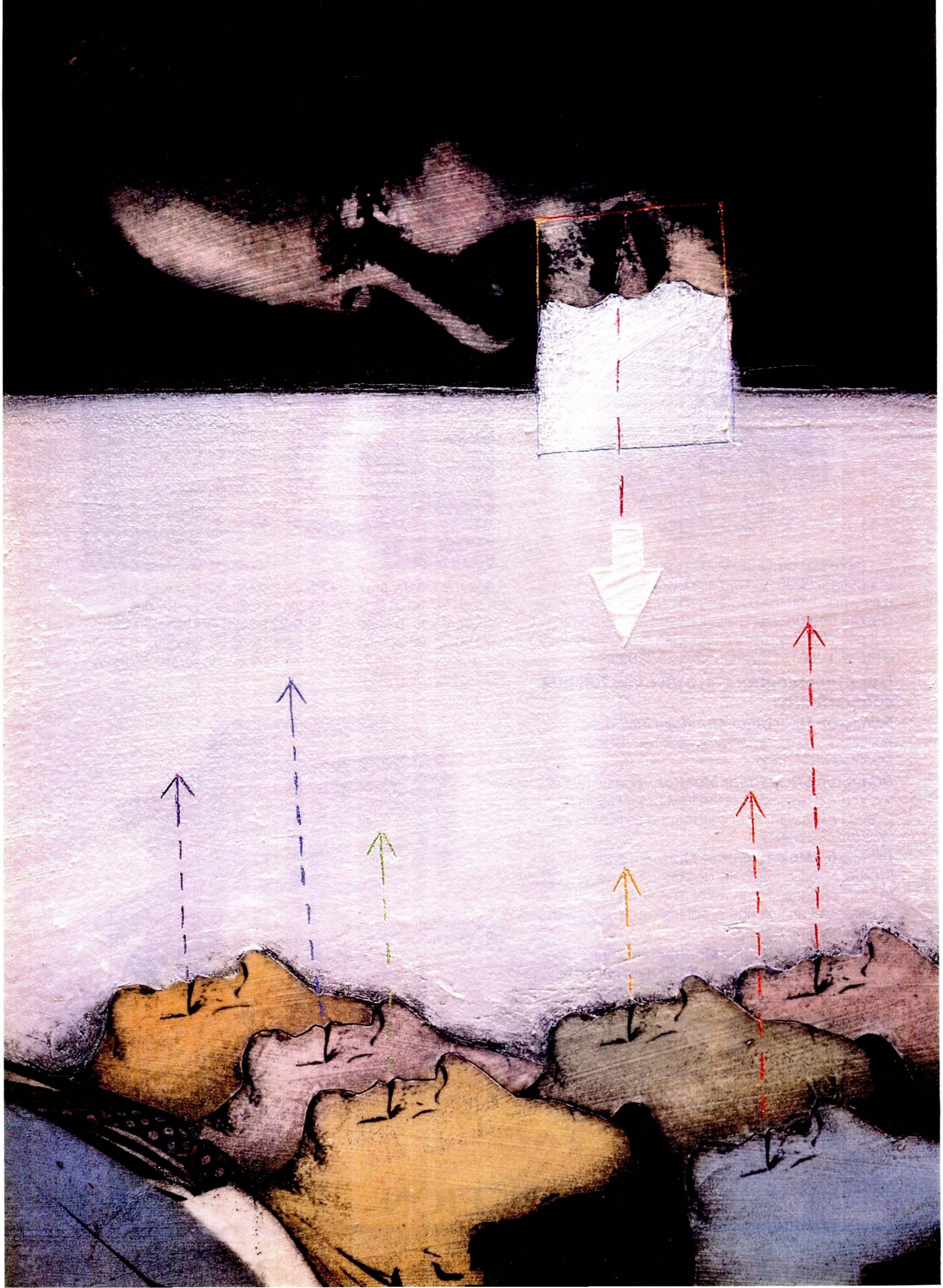
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Computer Conferencing

COMPUTER CONFERENCES bring together people with similar interests and complementary needs to exchange information and discuss problems. Conference participants can join a discussion whenever they please, wherever they have access to a computer or a terminal, a modem, and a phone line. Often, in fact, conference members carry on lively discussions with people they have never met face to face. BYTE's own conferencing system, BIX (BYTE Information Exchange), is a good example of this emerging trend, with active discussions on hundreds of topics of interest to BYTE readers.

This month, Brock Meeks's "An Overview of Conferencing Systems" compares several conferencing systems, including systems designed for business, academia, research, and general discussion and recreation.

Many people who use conferencing systems and electronic bulletin boards extensively find themselves subscribing to several services. Communication between conferencing systems would allow users to expand their information networks without the confusion involved in joining many systems. This sort of exchange of message traffic requires standards, however. "Conferencing Standards" by Jacob Palme offers guidelines for these standards.

The internal structure of a conferencing system can affect its flexibility and efficiency. Three articles in this issue—Alastair Mayer's "Storage Architectures," Jacob Palme's "Database Structure in PortaCOM," and "Conversations" by Douglas Comer and Larry Peterson—describe effective solutions to problems inherent in designing conferencing systems.

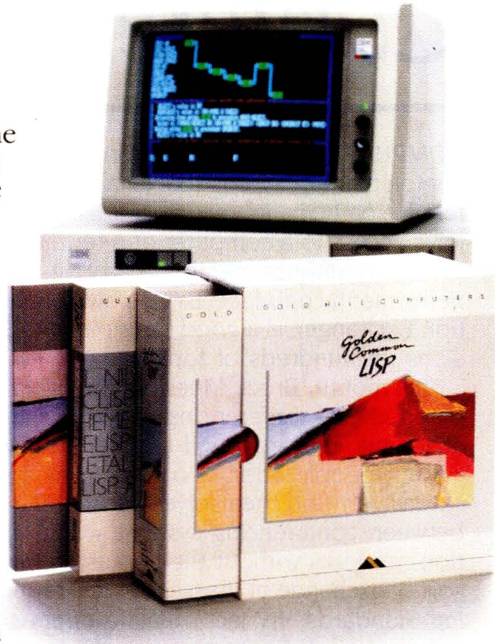
"Common Ground" by Chris Hancock describes a microcomputer-based conferencing system designed to be flexible and easy to use. "The Network Application Manager" by Robert Flavin and Jack Williford details the design and implementation of GRANDiose, a huge network-based system that can support any application that involves communication.

It seems a shame to waste the power of the microcomputer by using it as a dumb terminal when, with proper programming and cooperation from the host system, the micro could handle much of the processing involved in conferencing. Chuck McManis's "Local Power in a Remote Link" and Sherwin Levinson's "Cross-System Conferencing with CLACR" approach this problem.

As more and more people discover the advantages of computer conferencing over more traditional forms of communication, electronic communities are beginning to take shape, bringing together people of diverse backgrounds and similar interests to exchange ideas and information.

—Donna Osgood, Associate Editor

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AN OVERVIEW OF CONFERENCING SYSTEMS

BY BROCK N. MEEKS

A guided tour through COM, EIES, PARTI, NOTEPAD, *and other systems*

NUOSO LIVES on the African continent. Exactly where he lives and the name of his tribe is not important; Nuoso is a nonperson. Convicted of a crime against his tribal society, he is forbidden to communicate with his family, his friends, in short, with anyone. His communication cut off, Nuoso quickly withdraws from the village. Eventually he will cease to exist even in his own mind, and he will literally die from lack of communication.

Just as people need food, water, and shelter, so they need to communicate. From the earliest days of history, our ancestors sought better ways to communicate. Primitive maps scrawled in the dust gave way to cave paintings, where information retrieval entailed nothing more complicated than remembering the right wall in the right cave. But just as society became more complex, so did the communication needs of the population.

Early telegraph links, in Napoleon's time, had signal speeds of about two characters per second. In 1913 vacuum-tube repeaters were introduced to telephony, and a rapid succession of advancements in the world of electronics followed. In 1918 the first carrier system permitted several voice channels to occupy a single pair of wires. The early 1940s saw high-capacity coaxial cables beginning to replace twisted-pair cables. Microwave links emerged in 1946 with the capacity to carry more than 10,000 telephone channels. Today's phone system uses satellite links and will soon use fiber optics. In a hundred years our communication capability has risen from fifteen to a billion bits per second, from two to over a hundred million characters per second. And all for the sake of improving communication with each other.

THE BIRTH OF COMPUTER CONFERENCING

Early in 1970, political and economic pressures set the stage for the creation of a revolutionary means of communication. In the fall of 1971 the entire economic structure of the United States fell under the control of President Nixon's wage-price freeze. Because of the tremendous need to handle the reporting and information dissemination of the price freeze, the Office of Emergency Preparedness (OEP) commissioned Murray Turoff to create a computerized version of the "conference call." Turoff responded by developing the Emergency Management Information System and Reference Index (EMISARI).

The EMISARI system operated as an electronic network linking the ten OEP regional offices. The new price controls created a nationwide demand for information, guidelines, rulings, official statements, and policy clarifications from businesses, labor unions, and administrators. Because EMISARI eliminated the constraints of time and geographic location, the OEP's regional administrators were able to secure time-critical information at their convenience. The instant access of EMISARI allowed Washington to update policy as it happened and gave all involved the opportunity to respond or ask questions—with both

(continued)

Brock N. Meeks (161 East Main St., San Diego, CA 92020) is a freelance writer. He can usually be found on line in places too numerous to mention.

answers and responses maintained on line for all to review. This revolutionary idea of storing messages on line and allowing "many-to-many" communications became the first computer-based conferencing system.

EMISARI consisted of two systems: Party-Line, the computerized counterpart of the telephone conference call, and Discussion, an on-line "file cabinet" of topic-specific messages stored on line for all to see and comment on. These two elements became the building blocks for the computer conferencing systems of today.

Although EMISARI was preceded by the Department of Defense's packet-switched message-transfer network ARPANET, the history of computer conferencing after EMISARI reads like the Bible's first chapter of Matthew: EMISARI conceived two offspring, Party-Line and Discussion. Party-Line and Discussion begat EIES. EIES begat PARTICIPATE, which bore many sons (revisions). And so on. What follows is an overview of these and other top computer conferencing systems.

COM: Gateway to the World

Developed by the Swedish National Defense Research Institute starting in 1977, COM has since undergone many revisions and has even spun off a "portable" system called PortaCOM. PortaCOM, developed by a joint European research project, is designed to act like its big brother COM while running on a variety of different computers and operating systems. Because the two systems are almost identical, I'll refer to them both as simply "COM."

COM operates as a gigantic international electronic mailbox, with one incredible advantage: It offers full-blown computer conferencing capability.

COM is a gateway to the world of networks because it lets you route electronic messages through a complicated maze of networked computer systems around the world. Using computer systems at strategic sites as "gateways," COM routes your message to just about anyone that participates in an electronic mail (E-mail) system. (A gateway is a computer that acts as a switching point between various networks. COM sites do not have direct access to computer systems on ARPANET, for example, but by routing messages through a gateway system—one that does have access to ARPANET—it can deliver messages to ARPANET sites.)

What separates COM from the standard computer-based message system is its ability to create and maintain computer conferences. It also lets you create "parallel" conferences on systems that use COM. Parallel conferences allow participants at different sites to contribute to the conferences without logging onto a remote computer. New additions to the conference are then forwarded to the other participating computer systems and placed in the appropriate conference. Thus, identical conferences reside at separate locations.

COM operates mostly in academic and research environments and carries a very academic personality. This personality doesn't make for a lot of light conversation. However, if you want to extend your knowledge base in a global way, COM is the route to go. High-level technical discussions abound, and anyone who is anyone in computer development is within reach via COM. But there is a price to pay in that the system is difficult to learn. Experienced computer conferencing/electronic mail users will pick up on the system's intricacies in the first few on-line sessions, while a novice could be hopelessly lost. So much is possible on COM that a new user is overdosed on a plethora of menus for almost every possible user response.

Once you have slogged your way through the basic commands (to read messages, join conferences, and comment on messages), you begin to appreciate the power of COM.

Any person can create a new conference (yes, there is separate menu for that as well); however, statistics published by the system's developers show that users are reluctant to do this and instead use the comment capability to create a sort of "comment tree." The comment tree functions like a branching capability and lets you follow a particular line of thinking without the formality of creating a separate conference.

There is no subscription service for COM in the U.S., so to use it you must be affiliated with an organization or institution that is using the system.

For all the complexity and seriousness that is a part of COM, I found a refreshingly wry sense of humor residing just below the surface. Plowing through the seemingly never-ending command structure, I hit on something called "Get Encouragement." Like the U.S. Cavalry in a John Wayne movie, COM delivered the following to my weary 9-inch CRT:

> You are a very special person, beautiful and wise, respected by everybody around you. You are doing a splendid job. Many people love you, body and soul. You make life easier for others. You are a very warm and sensitive person.
>
> Be proud of being You! You have a very good reason.

EIES: Customized Conferencing

Murray Turoff's Electronic Information Exchange System (EIES), itself an offshoot of EMISARI, is the "biological" breeding ground of the computer conferencing world. It is the example that all other computer conferencing systems have followed—and improved upon.

Like any venerable software in today's computer environment, EIES has shouldered its share of abuse from critics and the new kids on the block. The complaints range from "Its response time is too slow" (true) to "The commands are so numerous you can never learn them all" (also true). But a software package doesn't thrive (or even survive) if it does not have solid support and input—both of which EIES is privileged to have, and from some of the best computer minds in the on-line community.

Scanning the various conference rosters (EIES has hundreds of con-

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ferences on line at any one time, and each conference maintains a separate roster of members), the EIES "community" begins to read like a who's who of the computer industry.

EIES's many commands, their options, and the modifiers to the commands seem endless. Someone has said that even Turoff doesn't know all the commands and the full capability of the system anymore. That is because so many people have helped with the development, creating various command sets in an effort to build the system's efficiency.

The system offers help on line (even a "Chinese menu" that allows you to create personal subsets of EIES commands, which you can rename to your liking). If you need a quick command fix, an ever-present "?" key reveals the EIES Survival Guide (and a handy piece of phosphor it is).

EIES is a curious mix of technical, academic, and nonsense conferences whose topics range from High-Level Programming Techniques to Computers in the Third World to Graffiti.

Rummaging around EIES, you almost get the feeling that you're some kind of electronic archaeologist. Conferences that at one time virtually exploded with discussion comments now lie dormant, the last entry dated, in one case, March 17, 1983. What happened to all those hundreds of participants? A "dead" conference is something of a cultural phenomenon in the Information Age, and EIES contains plenty of these kind of conferences to explore.

In keeping with the pioneer spirit of the system, a couple of EIES users have been attempting to trace and chronicle the vast electronic rivers and tributaries of the world's research networks (ARPANET, USENET, CSNET, MAILNET, and so on). In so doing they are a kind of Lewis and Clark of the Information Age. Because EIES has access to the research networks via a MAILNET gateway, users of EIES have access to just about any research or academic institution that has electronic messaging capability.

EIES has a real-time capability that boils down to an electronic, person-to-person exchange of one-line electronic messages. There are two modes of sending a real-time message. One is the "flash" method, where the receiver is greeted with a one-line blast of text on his or her screen. This often causes (without too much surprise) a reciprocal action, and usually a message of like content is broadcast to your CRT. This is all done in a "semisynchronous" fashion. In other words, both parties are sending one-shot messages without really making any kind of link between their machines. If you want to engage in an extended "chat" mode, EIES allows this via its +LINK command. Using +LINK, two people can carry on a conversation much faster, as the +LINK has actually "linked" their machines via software.

Though EIES does have some shortcomings, there isn't a lot you can't do on it. If you find something you can't do, chances are someone is working on the solution right now. The whole system reminds me of draft horse: It may be big and slow, but it will never quit.

IT'S PARTI TIME

The PARTICIPATE conferencing system offered by PSI (Participation Systems Incorporated) is aptly nicknamed PARTI.

On line with PARTI you immediately sense that a kind of electronic party is being carried on in the phosphor—this is computer conferencing for the masses. Talking to users (and using the system itself), you get a feeling that using PARTI really means "belonging" to PARTI.

C. H. "Harry" Stevens, developer of PARTI and president of PSI, is known throughout the industry by a bit of online folklore surrounding what has become a personal trademark for him—the Eskimo word "chimo," which means "I'm your friend."

During a "name that newsletter" contest for the EIES conferencing system, Stevens suggested "Chimo" (the same name used for a newsletter he published as a consultant at MIT). The name won and is a de facto standard for PARTI on-line newsletters.

Stevens developed PARTI while working on the EIES system. Frustrated by the large amount of chatty conferences on EIES, Stevens began to develop a way to break a large topic into "sections" through what he calls "inquiry networking." (Ironically, PARTI has evolved into the ultimate chatty on-line system.)

Inquiry networking allows a conference to have many different *branches*. For example, a conference titled Programming Languages might have branches dealing with Ada, Turbo Pascal, BASIC, and so on. Once a conference has been *organized*, anyone involved in the conference can create a branch—which sometimes results in an unwieldy conference structure (a branch conference can have several branches itself). Should this happen, the original conference organizer can choose to *prune* the conference by deleting disruptive branches.

Creating a conference on PARTI is as easy as expressing your personal dogma. As a conference *organizer* (creator) you are free to choose any topic you wish. Conferences on PARTI run from the esoteric (Meditation and Heightened Sexual Awareness) to the serious (such as the national headline-grabbing conference that took place after the 1983 downing of Korean Air Lines Flight 007) and all topics in between.

One unique aspect of PARTI is that users play a major role in its ongoing development. Originally just an overlay on the EIES system, PARTI first went public (on the commercial information utility The Source) with an organizational structure that was the result of suggestions and comments made to Stevens by EIES users. Even now, an ongoing conference on The Source acts as a clearinghouse for suggested improvements. Stevens takes such suggestions into serious consideration. The Suggestions conference on The Source (which uses PARTI version 3.4) led to the development of the much-improved version 4.45.

PARTI lets you operate a flexible range of on-line tools such as a

private, person-to-person message system, searching a conference by a keyword or phrase, on-line balloting, and a person-to-person real-time messaging capability. You can send a one-line message in real time to any other person using PARTI, to which they can respond in like manner. This is not an efficient method of real-time conferencing, but it's good for "routing" someone to a critical conference he may have missed or for setting up time to get together on a voice call.

The ability to create *open* or *closed* conferences gives a conference organizer the ability to tailor the membership of any conference to his or her specifications. A conference can consist of as little as one person (pretty boring, but you don't catch a lot of flak about your opinions) to literally thousands.

PARTI is not the easiest system to use. It has many undocumented features that can remain unknown until you get your hands on a user's manual. A manual is available from PSI, but most public systems don't tell you that, choosing instead to furnish you with their version of a "cheat sheet." Without the user's guide in hand, you can build up a good deal of frustration and a sizable bill. On-line help is available, but it's only as good as your latest question. Overcoming the initial frustration, however, is well worth the time (not to mention the expense). Soon the frustration turns to fun (or addiction, depending on your self-discipline), and after a while Chimo certainly seems an apt

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Computer Conferencing and Technology Transfer

BY PATRICK L. SWEET

Computer conferencing is integral to the information and technology transfer network being developed by the Industrial Technology Institute (ITI) of Ann Arbor, Michigan, to encourage the application of advanced manufacturing technology (AMT) in the United States.

AMT falls into the category of "programmable" manufacturing technology, which refers to manufacturing technology that can be programmed for one operation and then another. In AMT, machines may or may not be integrated by a central computer, but they usually work in tandem with other programmable devices that minimize human intervention in the production process.

ITI is a not-for-profit corporation initiated in 1982 by the State of Michigan's High Technology Task Force to conduct basic research in the area of automated manufacturing, develop new techniques, and serve as a technology transfer agent between those who are familiar with AMT and those who are not.

To encourage the use of AMT, ITI plans to use computer conferencing for three areas. First, as a complement to face-to-face seminars that address the application and implementation of specific technologies, computer conferencing will be used to extend seminars and training programs over a period of time. Programs will be marketed to the advanced manufacturing community, including companies, trade and professional associations, academia, and government agencies.

ITI also anticipates the development of *technology-specific* forums (e.g., forums on robotics, machine vision, or computer-aided design). These will be offered to the manufacturing community at large or may be organized for specific companies or users of a particular vendor's systems. A forum may be designed as a user support group, modeled after personal computer user groups, or as a means of sharing current research in an area of AMT or its application.

ITI will also offer project-focused communication services. Companies about to deploy various technologies or solve specific technological problems in different sites often establish task forces to coordinate the effort. Whether in the early stages of investigation or in the late stages of implementation, tight communication between sites can enhance deployment efforts. In addition, professional associations responsible for developing industry standards may use computer conferencing to coordinate standards-development projects. Other company- or organization-specific services are planned.

ITI has organized a number of computer conferences already. Its first, "The Forum on Integrating Research in Socio-Technical Systems," lasted six months and was initiated primarily to develop a research agenda for ITI's Center for Social and Economic Issues. With participants from industry, government, and labor and academic organizations, the conference proved to be a valuable follow-up to a face-to-face conference titled "Managing Manufacturing Technologies Through the 1990s," cosponsored by the National Science Foundation. This initial experience provided ITI with important insight as to how to successfully organize and run a six-month-long "discussion," something that takes a good deal of experience and motivation due to the unique characteristics of computer conferencing.

Computer conferencing at ITI will take a variety of forms and is becoming an essential means for enhancing discussion and information exchange among those familiar with AMT and those just becoming aware of its potentials and implications. ITI's computer conferencing network promises to be a powerful tool for enhancing the understanding and diffusion of advanced manufacturing technology.

Patrick L. Sweet (ITI, Information Systems Center, POB 1485, Ann Arbor, MI 48106) is a research associate at ITI.

motto for what is often called an impersonal medium.

NOTEPAD: THREE-PIECE CONFERENCING

NOTEPAD is the three-piece suit of the conferencing world. This conferencing system is a stripped-down, easy-to-use, no-nonsense business tool. Using NOTEPAD may remind you of a corporate boardroom meeting.

NOTEPAD feels less powerful than some of the other commercial conferencing systems, but this is because of its inherent simplicity. The number row of your keyboard (1–9) activates the entire range of NOTEPAD commands. A small three-page fold-out brochure holds all the commands and is written in straightforward English.

COMPUTER CONFERENCING: THE GLOBAL CONNECTION

BY LAWRENCE B. BRILLIANT

As if in pain, the helicopter's jet turbine engine screeched sharply, groaned once, and died. Now, silhouetted against the Himalayan mountains, the quiet helicopter began to spiral slowly toward the ground. The passengers, a group of United Nations doctors, looked around furtively as the pilot, his jaw clenched, maneuvered the paralyzed bird down in tight circles.

After a silent eternity, the pilot brought the craft down just outside of Biratnagar in the remote terrain of Nepal.

"What's wrong?" a passenger asked.

"Nothing much," the pilot replied. "But we'll need to file a spare parts order: 'Engine. One.' "

Under almost any other circumstances, a crippled aircraft sitting on the ground in one of the most remote places on earth would rust long before a replacement engine could be located, airlifted in, and installed. But thanks to the then-new technology of computer conferencing, a worldwide "spare parts order" was filled swiftly, and the chopper flew out of Nepal only days later.

Here is how computer conferencing rescued that helicopter and the U.N. project:

The helicopter was on loan from Evergreen Helicopter Company in McMinville, Oregon. The only "spare" jet engine was in France, at Allouette Helicopter Company. Four additional organizations were involved in orchestrating the "spare parts order": the United Nations office in New York, the government of Nepal, the World Health Organization regional office in New Delhi, and a Michigan-based international charity, the Seva Foundation, which was funding the project.

Using a computer conferencing system to which several companies in the aerospace industry subscribe, an "electronic forum" was quickly convened. Despite the differences in time zones, computer terminals, and geographical locations, the participants were able to take part in an on-line meeting in which they could read the views and positions of all the other organizations. They quickly reached a consensus on who would pay for the replacement engine, how it would be shipped into Kathmandu, how customs duties might be waived on the new engine, how it could be trucked into the remote landing site, and what would be done with the damaged but still valuable original engine. Telephone tag, internal organizational hierarchies, and diplomatic protocols were dealt with easily, and the meeting lasted less than a day.

This event illustrates a lesson for anyone trying to get things done in complicated organizations. When speed and effectiveness are the issue, nothing surpasses electronic forums for disseminating information to all concerned and making decisions rapidly.

Today, the computer conferencing revolution is burgeoning, due to three factors: (1) The enormous investment made in the international telephone system in past decades has provided us all with relatively low-cost communication lines. (2) Technology has brought the cost of personal computers within the reach of virtually everyone in modern industrial societies. (3) Increasingly sophisticated software enables individuals to take part in computer conferencing at home and gives them the option of renting time on worldwide networks.

Until now, organizational culture has been determined by a critical mass of intelligent people in proximity to each other. This has created towns, universities, and tall office buildings. It is why we have Bell Labs and Xerox PARC.

With the advent of electronic meeting technology, the thrust of civilization can now occur without the factor of proximity. The synergism and excitement of a critical mass of intelligent people will remain a factor, but now they need not live or work close to each other. For the first time, engineers in San Diego, New York, Rome, and Hong Kong, all members of a special-interest group, can meet on line all year without ever seeing each other. Perhaps, with this technology, we are seeing the realization of Marshall McLuhan's "global village."

The benefits to business are obvious: Decision making is improved by bringing the best minds of a company together without restrictions of time and location; participants can productively enter a meeting after organizing ideas; they can discuss many different subjects in one meeting without the confusion that sometimes occurs in traditional meetings; immediate printed records of the discussion are available; and spreadsheets, databases, and other productivity tools can be entered into the meeting. Used wisely, the result is increased efficiency.

Computer meeting systems can make a horizontal cut through the standard vertical organizational chart. This

NOTEPAD provides a combination of real-time and stored-message conferencing to build the contents of a message base. A real-time computer conference discussion can consist of up to 32 people on line at the same time. Messages are stored sequentially as they are entered by each individual. These real-time messages then become part of the complete stored-message base. This storing of real-time conference messages allows you to arrive late to a conference and quickly review all that has been said up to the time you logged on. You can even miss the entire real-time conversation, log on later, review the entire discussion, and add comments, which the others will see the next time they log on.

A Service option lets anyone in the conference create a survey ("How can we increase sales in Outer Mongolia?") or post an on-line ballot ("Should we go public with our stock?"). Members of the conference respond in essay fashion to a general survey or by "voting" (yes, no, or abstain) on ballot questions. The creator of the survey or ballot can compile the results with two keystrokes and send the results to the rest of the conference members.

Conference contents can be searched by keywords or phrases, time, dates, or person—even during a real-time conference.

NOTEPAD is marketed through InfoMedia, which is headed by computer conferencing pioneer Jacques Vallee. Vallee's influence on the concept and personality of NOTEPAD is obvious. A longtime advocate of the importance of putting the human factor in computer conferencing, Vallee has succeeded in transferring that human factor into the environment of person-computer-person communications. NOTEPAD operates under a general philosophy of "people first, then machines." This attitude leads to the phrase "transparent technology," which InfoMedia uses to describe the NOTEPAD conferencing environment.

NOTEPAD is used by corporations like Bechtel to coordinate worldwide construction projects and by governmental bodies such as NASA, which is running an ongoing international research and development conference. For this reason, most of the conferences are closed, meaning the contents are known only to the participating members. Even NOTEPAD's support and service team does not have access to conference contents, unless it is specifically invited. This high degree of confidentiality appeals to businesses needing to discuss sensitive issues while taking full advantage of computer conferencing technology. As a consequence, this is not a system to which you would subscribe. Most users are involved in specific projects, and the sponsoring organization picks up the tab. If you're lucky enough to use NOTEPAD, you'll find what that ambiguous phrase "user-friendly" is really all about.

eFORUM: NEW KID ON THE BLOCK

Chronologically speaking, eForum from Network Technologies International Inc. (NETI) is the youngest member of the computer conferencing family. Being the youngest, eForum has some big shoes to fill, but it appears to be off to a good start.

NETI has a long history of working with computer conferencing, and that experience shows in the features of eForum. Drawing heavily on the electronic meeting theme, eForum is another attempt to draw the business meeting into the Information Age. To achieve this goal NETI has pumped eForum full of user-friendliness while bypassing most of the "computerese" that makes boardroom executives cringe behind walnut desks. The company has also developed a slick documentation manual and a slick advertising program. If you want a computer conferencing system that "feels" like it belongs in a BMW or on the cover of the *Wall Street Journal*, this is the package.

The documentation is by far the most complete and accurate (though not error-free) that I received during my electronic journey of conferencing systems. To a novice user, documentation is priceless. NETI gets high marks for its efforts in this area. Included in the documentation is an excellent discussion of the "how to's" of electronic meeting management and organization (no simple task, I assure you).

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distributed electronic organization (DEO), a horizontal stratification of personnel within a company, results in a new and higher quality of interactive group process and organizational decision making. For the first time, through computer conferencing, we will see communication exchanged on a continuous basis between all the department managers, all the engineers, and all the supervisors, no matter where they are located. These horizontal levels of communication will remove previous barriers of time and location, allowing unlimited communication in a thoughtful, productive process.

The Seva Foundation, a nonprofit international charity, is a good example of a DEO. It uses electronic meeting systems to allocate its money and make other business decisions. The board of directors meeting lasts all year, and, as a result, the structure of the organization has changed. The executive committee, whose members once flew from various corners of the world for meetings four times a year, has been abolished. Now the entire board is intimately involved on a day-to-day basis with operational decisions, though the members live all over the world.

The impact of these horizontal links within society is still difficult to foresee, but from this free exchange of ideas and information will come new solutions to old problems.

Lawrence B. Brilliant, M.D., M.P.H.J., is the founder and chairman of Network Technologies International Inc. (NETI), which markets eForum and docuForum electronic meeting systems. He can be reached at NETI, 315 West Huron, Suite 320, Ann Arbor, MI 48103.

eForum provides what it calls an eForum WS software package (the WS stands for workstation) that is compatible with IBM PCs and their clones. The WS software handles communications, word processing, printer control, and uploading/downloading procedures by interfacing with eForum's command set. The software uses an abundance of windows, similar to today's desktop utilities programs, although you don't have to have this special software to interact with eForum.

When I first used the system, I ran my workhorse engine: a pre-1984 Kaypro 2, a Prometheus 1200-bps (bits per second) modem, and MEX public-domain software. This setup worked flawlessly (though it was like eating plain yogurt after running the WS software).

NETI bills eForum as the "electronic meeting manager." True to its claim, it is just that: a meeting manager, with no electronic mail function available. One way around this is to organize a closed meeting between two people or among a small group. (I've been told that NETI is close to releasing an integrated E-mail program.)

As in other systems, comments entered in a conference are readable by anyone who has access to the conference. There are four different levels of security you can assign to a conference. The security levels range from Open (which even the corporate janitors could contribute to if they had access to a micro) to something bordering on paranoiac—a closed, invitation-only conference that requires a special code word to enter.

Using eForum reminds me of a formal business meeting; this is indeed a "structured" system. Major discussion topics (such as Software Development) are listed as Meetings. These meetings can then be divided into various discussions (such as User Documentation). Anyone involved in the meeting can create a new discussion (bring up a new topic). In these different discussions you can read others' comments and contribute your own views. A particularly intriguing command is listed as punt (as in "when all else fails—punt."). Punt does exactly what you might expect; it logs you out of the system and returns you to the log-in sequence, giving you a second chance at a particular on-line session. (If only NETI could transfer the electronic punt command to face-to-face business meetings!)

If a discussion runs its course, it can be tabled, which removes it from the general meeting structure. This "self-cleaning" keeps the main topic manageable and creates an atmosphere of a face-to-face meeting where discussions are started, talked through, and then dropped.

With the growing move to regional information networks (like the Whole Earth's WELL and NETI's own M-NET), eForum could be a package that springboards this new breed of network into prominence. And while eForum is not yet powerful enough to handle the needs of a Fortune 500 company, a large corporation might do well to have several eForums available for its smaller intercorporation divisions.

PUTTING BYTE INTO CONFERENCING

Alastair J. W. Mayer leads a charmed life. Born in London, England, in December of 1952, he just missed the infamous "Killer Fog." After several careers as a country club kitchen helper, typist, tobacco planter, and bartender, Mayer became terminally involved in the computing field during a 1974 Computing 101 course, which forced him to learn APL. He says, simply, "I was hooked."

Winding his way through various "rent-a-programmer" jobs, Mayer ended up at Concordia University in Montreal. After revamping a

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	Monitor	User	•	•	—
	GA-1000 Graphics Adapter	•	•	•	1 Full
	PC-EYE Video Capture	•	•	•	1 Full
	PhotoMail Software	•	•	•	—
	Modem	User	•	•	•••
	Video Camera	User	•	•	—
RECOM-MENDED	Pointing Device	•	•	•	1/2 Slot
	ScreenMaster	•	•	•	1/2 Slot
	Camera Accessory Kit	User	•	•	—
OPTIONAL	Expansion Chassis (8-Slot)	User	•	—	1 Full Slot in host for interface
	Printer	User	User	User	1 Slot for printer adapter

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documentation system for the Academic Computer Services department, he wrote his own mainframe-based text formatter called FORMAL. His intensive research and development work with the Interactive Graphics Lab led him to develop VAXteroids, a mainframe color-and-sound version of the popular Asteroids video game. After VAXteroids was written, Mayer searched for a real challenge and ended up at Canada's University of Guelph working on CoSy.

CoSy, a blend of many different computer conferencing systems, echoes its developer's own background. CoSy is a type of academic system (like EIES), while maintaining a sense of electronic community (like PARTI). BYTE has chosen CoSy as the software that BIX (the BYTE Information Exchange) will run under.

CoSy is a deliberately ambiguous acronym that originally stood for Conferencing System, Collaboration System, Conversational Syncretism, and even multilingual names like Conduité à Synérgie (conduit to synergy). This identification crisis sums up CoSy well and is also the reason it functions well in a computer conferencing environment; it can be anything you want it to be.

The CoSy conferencing system at Guelph has officially been on line since April of 1983. "We started charging people real money for the service in the fall of 1984," said Mayer. The University provides individual accounts on CoSy, on a per-fee basis. To date there are 400 off-site users in 28 different countries using CoSy, notably by organizations that are geographically dispersed.

CoSy runs on any machine that will handle UNIX. Mayer says the software was demonstrated successfully on an AT&T UNIX PC with 1 megabyte of RAM (random-access read/write memory) and a 10-megabyte hard disk (with obvious limitations regarding simultaneous users and number and size of conferences).

CoSy supports electronic mail and both open and closed conferencing. In addition, a function called Conversation lets users form an informal conference of invited members. Conversation looks like regular E-mail, but when you enter comments, each person on the "guest list" is sent a copy of the message. This facilitates quick conferences without going through the formalities of setting up an official conference.

CoSy has numerous on-line help functions and even a "guided tour" that allows you to learn enough commands in 10 minutes to handle 80 percent of all the functions you will ever use on CoSy.

To make CoSy respond, you only have to hit a carriage return. If there are unread messages waiting for you, CoSy automatically displays them. If you are ever in doubt about what to do in CoSy, you just hit a carriage return, and something will pop onto your screen. If it's not an unread message, then it will be a list of executable options. The CoSy installed at Guelph has links to the BITNET network and can therefore reach any number of research networks. (As pointed out earlier, figuring out these research networks is something of a black art, but the potential is there.) If you want to take a shot at on-line "exploration," you can subscribe to CoSy (at a much more reasonable fee than EIES) and begin traveling the tributaries of the electronic community.

According to Mayer, there is talk about linking the Swedish COM with CoSy, which would allow parallel conferencing between the two systems to become a reality.

CoSy represents a trend in computer conferencing that is highly desirable—portability from a mainframe environment to the micro level. This evolution could well lead to a

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vast network of high-powered conferencing systems dotting the phosphorescent landscape, in much the same way single-user bulletin-board systems do today.

VISIONARY CONFERENCING

The conferencing system AUGMENT can trace its roots to a 1945 *Atlantic Monthly* article by Vannevar Bush called "As We May Think." In the article, Bush described the "memex," a personal workstation that includes concepts such as associative indexing, windowing, and database trails. Drawing heavily on the concepts of Bush's article, Doug Engelbart began thinking of ways to "augment" the office work environment. As a result of early work in workspace augmentation, Engelbart developed a system called NLS.

Engelbart is often overlooked in the general history of the development of computer conferencing. In the early 1960s he wrote about the type of computer system that has evolved into modern-day computer conferencing. The focus of NLS was to create a complete "knowledge workshop" for the user, not just an isolated set of tools. The early NLS system was so impressive that in 1978 Tymshare took over the rights to the NLS system and now markets it commercially as AUGMENT.

AUGMENT allows you to navigate through what it calls an "information space," using several on-line tools. In a computer conference you can display text in several ways—by subject headers only, by controlling the number of lines displayed on screen at a given time, or by presenting text only from a certain person. The system also allows the screen to be divided horizontally or vertically into eight rectangular windows for displaying different sections of a text or separate sections of different texts. This use of a split-screen concept was an early forerunner of windowing so common today.

The manipulation of text on AUGMENT allows you to delve into what Engelbart terms "hypertext." In dealing with your "information space," you can jump to previously marked passages, to adjacent passages, to a specified point in the text, or to a point that satisfies a certain test. AUGMENT also lets users jump to other documents that are referenced in the current on-screen text. The effect is a type of "word window."

Beyond the normal aspect of storing written notes in a hierarchical fashion, with subsequent comments being added by other members of the computer conference, AUGMENT adds a fascinating dimension to the

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real-time computer conference. Users can link their terminals to allow for a common screen information display, with each person being able to control a pointer on the screen and able to call up related files on different windows.

In Engelbart's own words, AUGMENT "permits a user to call an on-line conference of two or more people, view and edit files, add and remove conferees, pass the gavel, and transparently connect to other machines."

Many of the concepts displayed in Engelbart's work with AUGMENT are being researched by computer conferencing developers today. The idea of a knowledge workshop goes beyond the basic needs of a computerized meeting room. It appears, however, that the types of concepts AUGMENT displays are still ahead of its time.

GENIE: Quill and Ink It Ain't

Stephen Heitmann, developer of the GENIE conferencing system, must have been a medieval monk in his past life. There is no other explanation for GENIE's highly flexible text-processing capabilities. Only a monk that had spent his entire life hand lettering with quill and ink could have turned all his frustrations into fantasies by creating a computer conferencing system with the capabilities of GENIE, which must have taken hard work, late hours, and a natural creative ability.

The first thing that hits you about GENIE is the many ways it handles text. Entering comments into a conference is handled in a standard way. You enter the comments into a scratchpad, and then the contents of your scratchpad are entered into the conference. That's where the standard procedure ends.

While participating in an on-line conference, you will sooner or later enter a message you wish you could take back, such as one written while you were mad or half asleep. Most conferencing systems allow you, as author, to delete a message if you choose. Revising the message might be preferable, but on most systems your options are to delete or suffer the consequences (usually an electronic mailbox stuffed with comments that don't exactly resemble fan mail). GENIE solves this all-or-nothing problem by letting you revise messages. You can even authorize "editing rights" to other members of the conference.

An example of this "many editors" function would be when issuing a general request for information. Instead of having everyone who replies to your message create separate entries in the conference, each person could append his or her information

(continued)

At NEC, monitors and printers are not peripheral issues.

All too often, brand-name CPUs are "bundled" with mediocre peripherals — a practice that makes for profitable sales, but does nothing for the system's performance.

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CONFER *can broadcast notices, called bulletins.*

onto your first request. In the end, you have a single message that amounts to a minidatabase of responses.

GENIE allows the author of a message to place certain locks on the text. You can stop anyone from copying a note you wrote and placing it somewhere else in the system. This hinders the "leaking" or mass distribution of critical information. (Of course, if someone downloaded the message to disk, he could upload it anywhere he desired.)

Who uses GENIE? I don't know, since its user base is proprietary. (I am sworn by a phosphor oath not to reveal the system I used to review GENIE.) I was told that the target market for GENIE is the scientific/engineering (read "research and development") community. That didn't make sense when I first heard it, but after using GENIE I see why. The science and engineering fields create an enormous amount of papers that need constant revision.

CONFER: Think Tank Without Walls

CONFER is a computer conferencing system developed by Bob Parnes that resides on a mainframe somewhere on the campus of Wayne State University in Detroit. Hewlett-Packard chose to license CONFER for its own use and now has an effective way to electronically link its employees, who are geographically dispersed among 100 major corporate divisions. HP's corporate "suits" have hailed CONFER as "the best thing on the market for distributed meetings." Meanwhile, the Army's Training and Doctrine Command uses CONFER for its "think tank without walls," called The Delta Task Force. The Independent Investor's Forum caters to investors with $5000 to $10,000 and dispenses advice to its subscribers via CONFER.

In operation since 1975, CONFER is a greenhouse for various think tanks and free thinkers. If ever a system could create a feeling of excitement, CONFER is the one. Bouncing around the various CONFER conferences, I was amazed at the level of "idea projection" taking place. This is due in part to the structure of the software.

The structure of CONFER and the philosophy behind it are based on "information mapping." This type of system, according to Robert E. Horn's book, *How to Write Information Mapping* (Information Resources Inc., 1982), includes the following principles and procedures:

- identifying
- categorizing
- interrelating
- sequencing
- presenting

CONFER follows these ideas in "mapping out" the way it handles computer conferencing.

CONFER differs from other conferencing systems in that its conferences are more circular than branching. A *conference* is described as "the basic social structure" of CONFER. Major topics of discussion within a conference are called *items*. Each item relates to the general conference theme. If you want to comment on a particular item, your comments are logged as *responses*, which are short, concise points of view or pieces of additional information relating to the item. Responses must be short and to the point because they are limited to 1500 characters (about 24 lines of text). If new ideas evolve from the responses to items, additional items can be entered into the conference. From what I saw, an incredible amount of discussion can take place under a major topic without straying from the general theme. Contributing to the overall creative force of CONFER is the ability to create an agenda for each conference.

The agenda function of CONFER allows you to digest a conference by grouping items under a single topic. For example, a conference titled Productivity may have 15 items relating to different aspects of human relations. In your agenda you can create the heading Human Relations and then cross-reference all the items relating to the subject. This gives you a powerful information-management tool. Since everyone interprets information in different ways, each person can create an agenda according to his or her personal perspective (or if you find someone who thinks along the same lines, you can share agendas).

CONFER can broadcast notices, which it calls *bulletins*. Bulletins can be sent to all members of a certain conference, informing them of activities or pieces of information. Additionally, bulletins can be time-released, so that you can create a bulletin on May 8 and instruct CONFER to broadcast it on May 30. (You can do the same thing personally, by sending yourself personal bulletins called *notes*, which come in handy for reminding you of important dates or activities scheduled in advance.)

Private correspondence is handled through the sending of messages. Messages function like a standard E-mail system.

CONFER is also the Ferrari of computer conferencing. This software responds quickly to all commands, including those calling for keyword searches of an entire conference database. Until you've been "under the clock," knowing that each tick-tick-tick is literally being measured in greenbacks, you can't appreciate a responsive system.

The most impressive feedback I received on CONFER was this user's statement: "When using CONFER, people don't think of themselves as 'subscribing to' a system; they feel like members of a community."

Choosing a System

How do you choose a conferencing system? The best way is to try out the various systems for yourself. All the companies marketing these systems are more than willing to let you test-drive their systems. After spending some time with each one, you'll know which suits your needs best. It will be the one that "feels" right. ■

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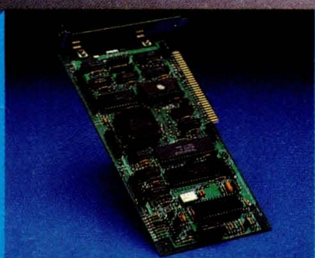
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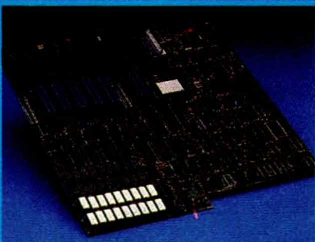
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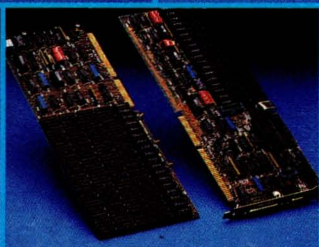
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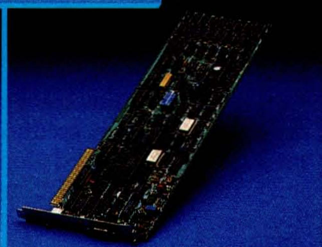
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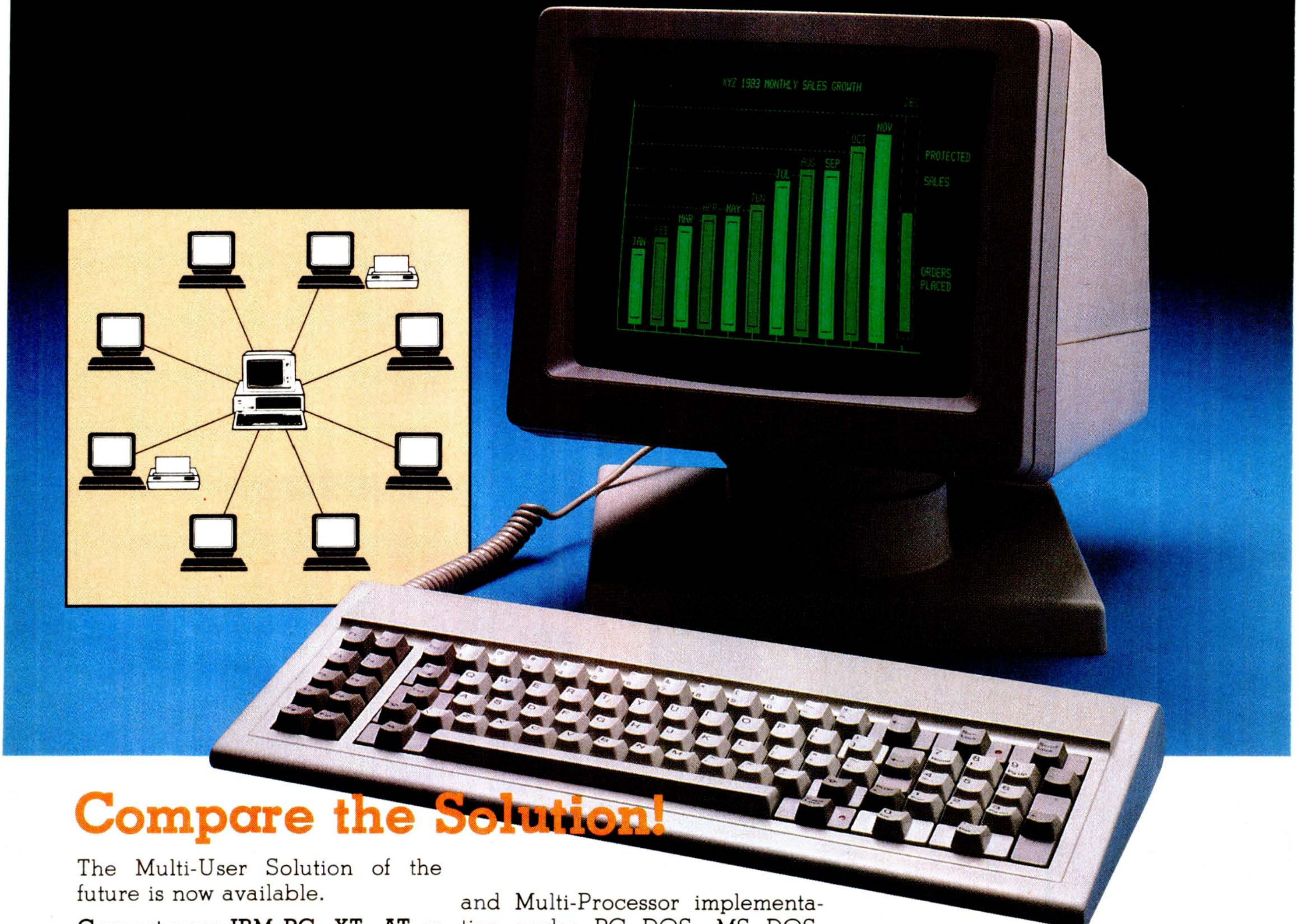


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CONFERENCING STANDARDS

BY JACOB PALME

The search for a universal conferencing standard continues

USERS OF A SINGLE computer conferencing system who communicate only with people who use the same computer have little need for standards. The need for standards arises when a user wants to communicate with people on several different computers or wants to connect a personal computer to a conferencing system.

If two different machines are to communicate, a standard for communication between them is needed. In computer conferencing, this could be either the interconnection of personal computers with multiuser conferencing systems or communication between several multiuser conferencing systems. Such a standard need not prescribe the internal functions, structuring, or user interface of the connected systems. The standard only has to prescribe the interconnection between the systems.

It is easier to develop a standard if you have some idea of the structure of the systems to be interconnected. Thus, standards are often based on models of the internal structure of the systems to be interconnected. The existence of such a model does not mean that only systems structured according to the model can be interconnected. A model that is used to develop standards and that does not exactly agree with existing systems is called an *abstract* model. To connect a system whose internal structure is somewhat different from the model requires some mapping between the model and the real system in the interconnection software.

Today, many people are forced to keep accounts in several different conferencing and message systems. A comprehensive standard for interconnections might allow them to have an account in only one system and get all their information through this system from conferences and people in other systems. They would then have to connect to only one system and learn only one user interface.

GROUP COMMUNICATION

Computer conferencing is a tool for communication within a group of people and provides an environment similar to task groups, discussion groups, and so on. A typical computer conferencing system consists of a number of conferences, each of which has a set of members and a sequence of messages.

Usually, the system stores information about how far every member has read in each conference; this is often called the *conference marker*. This makes it possible for the system to tell users which messages are new to them when they connect to the system.

Bulletin boards are tools very similar to computer conferences. In this article, "computer conference" will also refer to bulletin boards.

Another tool for group communication common in computer-based message systems (CBMSs) is the *distribution list*. A distribution list, like a conference, has a set of members. A distribution list, however, usually does not store messages. When a message is sent to a distribution list, the "list" will just expand the number of recipients of the message and forward it as individual mail to all the members

(continued)

Jacob Palme, chief researcher at QZ, Stockholm University Computing Center, studies the social effects of computers and specializes in research and development of computer-based message and conferencing systems. He is one of the developers of the COM and PortaCOM computer conferencing systems. He can be contacted at QZ, Stockholm University Computing Center, Box 27322, S-102 54 Stockholm, Sweden.

of the distribution list.

Some systems provide special facilities to support other group communication tasks like voting, scheduling of face-to-face meetings, joint production of a manuscript, and so on. The first versions of future standards will probably cover only conferences and distribution lists, leaving more specialized group tasks for future versions of the standards.

THE GROUP AGENT CONCEPT

Instead of developing one standard for each type of group communication, it is better to develop general concepts in the standard. For example, computer conferences and distribution lists can be combined into a more general concept called a *group agent*.

The group agent can store messages to be retrieved by some of its members, as in a computer conference, and forward messages as mail to some of its members, as with a distribution list.

Some group agents do not store messages and work as pure distribution lists. Other group agents may have no facility for automatic forwarding of messages and work as pure computer conferences. But many of the operations on the group agent (for example, adding a member or entering a message) can be similar for both kinds of group agents. This sharing of operations functionality for both types of group agents reduces the size of the standard.

A further advantage is that the group agent concept can be used not only to interconnect a conference system to other conference systems but also to interconnect to simpler mail systems. Conferences will then appear as distribution lists to users of the mail system, who will have the conference messages sent to them as mail, as shown in figure 1.

CONFERENCE-SYSTEM INTERCONNECTION

Since most conference systems can also handle personal electronic mail, one way of connecting them might be the one shown in figure 1. However, two other modes of connection are possible, as shown in figures 2 and 3.

Figure 2 shows a structure of parallel conferences. A similar structure for connecting distribution lists is possible. Every message entered into the conference in CBMS A is copied into the parallel conference in CBMS B. Any local user in either the A or the B system can read all the messages in the conference, originally entered in either the A or the B system, in the same way as in a stand-alone conference system.

The conference in system B, CB, can be seen as a member of the conference in system A, CA, and vice versa. Conference CA could work partly as a distribution list to ensure that a new message, entered into CA, is copied into CB, automatically forwarding all new entries (except those coming from CB) to CB. This is another reason why a good standard should combine computer conferencing and distribution lists into one general concept.

Of course, messages could also be forwarded from A to B only when B asks for them. This might be suitable if, for example, B is a personal computer that does not stay on line all the time.

Figure 3 shows an alternative structure, where messages are stored only in conference CA in system A. Whenever a user of system B wants to read a message, that message is retrieved automatically from system A. This, of course, requires fast networks to give users acceptable response times.

The structures shown in figures 2 and 3 can be combined. For example, system B might request the new messages from system A the first time any user wants to read them but then keep the messages for some time for other members of CB or for retrieval by the original reader who wants to look at the message once more.

DATA STRUCTURES

Standards for the interconnection of message systems need to define two things: an abstract model of the data structures involved and definitions of the operations used for communication between the systems.

Here is a typical example of the data structure and attributes for "members" of the group agent concept: A group agent will have a list of members. Members can be users or other groups (for example, a parallel conference in another system). Each member will have a number of attributes, defining his or her relationship within the group. Examples of such attributes are listed below.

Auto-forwarding: New messages to the group are forwarded automatically as mail to members with this attribute. It is used when the group agent acts as a distribution list.

Read access: Members with this at-

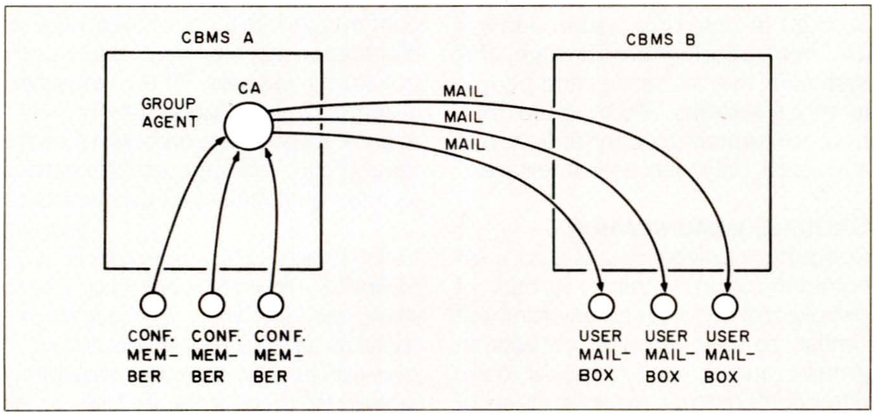


Figure 1: *In this alternative, the group agent* CA *in* CBMS A *will act like a group agent to local users, who get messages from the conference, but like a mailing list to remote users at* CBMS B, *to whom messages are sent by* CA.

tribute are allowed to request entries from the group.

Write access: Members with this attribute are allowed to enter messages to the group.

Organizer access: Members with this attribute are allowed to modify the list of members and other attributes of the group. Organizer access can be divided into different rights to modify various attributes. A special, but important, case is the right to modify only the value of an attribute with respect to yourself. You might thus be allowed to enter and remove yourself from the list of members of a group but not to enter and remove other members. In standards work, people with the right to modify information only about themselves are usually called *friends*.

The set of members with different rights in relation to a group need not always be defined by an explicit list of all the members. For open (public) conferences, for example, anyone may be allowed to read or become a member of the group. The set of members with a certain right may also be defined by what is known as a *class description*, for example, "everyone" or "all citizens of Sweden" or "all employees of IBM," provided that a database is available that can check whether a certain person belongs to a certain class or not.

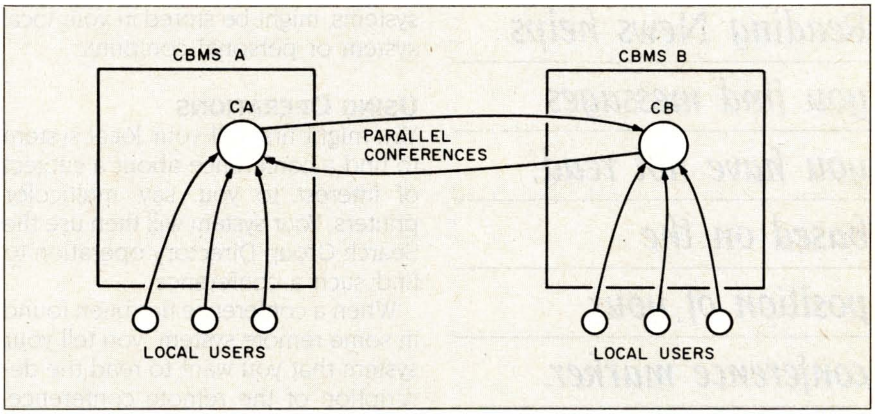


Figure 2: *There are two parallel conferences in this alternative,* CA *in* CBMS A *and* CB *in* CBMS B, *storing the same set of messages. Local users get the messages from their local instance of the conference. Mailing-list forwarding is done only between the two conferences, not to personal mailboxes.*

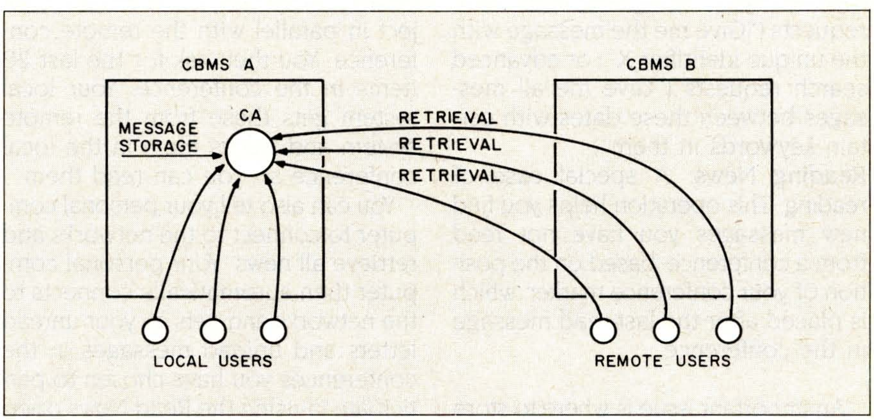


Figure 3: *In this alternative, messages are stored only in conference* CA *at* CBMS A. *Users at* CBMS B *get the messages at reading time from* CBMS A *using remote retrieval operations.* No *automatic forwarding of messages (mailing-list functionality) is used.*

MESSAGE DATA STRUCTURE

A very important property of a standard is the facility to give every message a globally unique identifier that will not be changed even if the message is forwarded many times or stored and forwarded again. Such an ID can, for example, be used to ensure that the relation between a message and a reply to it is preserved even if the message and the reply are forwarded at different times.

The basic data structure for messages is the conference. A conference defines an ordered sequence of messages. The same message may belong to more than one conference.

Another important kind of message data structure is the binary relationship between messages like "in reply to." Many other relations are possible, such as "continuation of," "subchapter to," etc. A standard will probably not place a restriction on such relations, such as allowing them only between messages within the same conference.

OPERATIONS

Operations between connected systems have to be fully defined in the standard and are in many ways similar to the operations that a local user of a conference system can perform from his or her terminal. Here are some of the main types of operations:

Search Group Directory: You might search the group directory to find where a conference exists on a particular subject that interests you. All groups in the directory may, of course, not be available for search by all users.

Creation Operations: Create and remove group agents.

Read and Set Attributes: Read and modify the attributes of a group, such as a list of members.

Membership Operations: Read and modify information in the lists of members with various rights in relation to a group.

(continued)

Reading News helps you find messages you have not read, based on the position of your conference marker.

Submitting Messages: Enter messages to a group.
Reading Messages: Retrieve messages from the storage connected to a group agent, using simple retrieval requests ("Give me the message with the unique identifier X") or advanced search requests ("Give me all messages between these dates with certain keywords in them").
Reading News: A special case of reading. This operation helps you find new messages you have not read from a conference, based on the position of your conference marker, which is placed after the last-read message in the conference.

An important issue is where to store this conference marker. If every message in a conference is identified by a sequential position number in the conference, the conference markers for all conferences, even on remote systems, might be stored in your local system or personal computer.

Using Operations

You might first tell your local system to find a conference about a subject of interest to you, say, multicolor printers. Your system will then use the Search Group Directory operation to find such a conference.

When a conference has been found in some remote system, you tell your system that you want to read the description of the remote conference. Your system will find this description using the Read Group Attributes operation. If you decide that you want to join the conference, your local system sets up a local conference (in your local system) on the same subject in parallel with the remote conference. You then ask for the last 20 items in the conference. Your local system gets these from the remote system and stores them in the local conference so you can read them.

You can also tell your personal computer to connect to the networks and retrieve all news. Your personal computer then automatically connects to the networks and gets all your unread letters and unread messages in the conferences you have chosen to participate in using the Read News operation. It will then disconnect, and you can locally read the new messages and write your replies and comments. You then tell your computer to connect again to enter the new messages you wrote locally, using the Submit Messages operation.

Layered Standards

Standards for computer network applications are based on layers. Each layer uses the facilities of the layer below. Figure 4 shows how two layers may relate to each other. Layer *N* sees a message consisting of a layer *N* header and a layer *N* body. Layer *N* sees the body only as a sequence of bytes; it does not understand any structure within the body. In layer *N*+1, however, what was only a body in layer *N* actually has a structure, for example, with a layer *N*+1 header and a layer *N*+1 body.

The MHS Model

The message-system model behind the X.400 recommendation (see the text box "Standards Work in Progress" below) is called the MHS (message handling system). The model is shown in figure 5.

The basic components of this model are user agents (UAs) and message transfer agents (MTAs). Every personal mailbox has one UA representing that user. Using the UA, a user can, for example, locally edit a message. When the message is ready, it is delivered from the UA to an MTA, and the MTA will forward the message to the MTA connected to the recipient UA.

The protocol used to communicate

(continued)

Standards Work in Progress

Two main international organizations are involved in developing computer conferencing standards. These are ISO, the International Standards Organization (whose U.S. member is ANSI), and CCITT, the International Telegraph and Telephone Consultative Committee (organization of telegraph and telephone providers). Important also is ECMA, the European Computer Manufacturers Association, which in reality also includes the major American manufacturers and provides input to both ISO and CCITT.

CCITT has developed a standard for interconnecting message systems, called the MHS (message handling system) or X.400 recommendation. (CCITT standards are called recommendations, not standards.) This recommendation was officially accepted by CCITT in late 1984. The X.400 recommendation is purely for interconnection of personally addressed mail—there is no facility in it for group communication, not even for distribution lists.

ISO will soon adopt a standard called MOTIS that is a copy of X.400 with minor revisions.

ISO decided in April 1985 to ask all member countries whether ISO should begin to study the group communication area. This vote will probably be ready in late 1985, and, if positive, ISO will begin work in the group communication area in 1986.

During the autumn of 1985, CCITT began studying possible revisions and extension of X.400.

The MHS is a model of message exchange; it is not a description of how a message system must be organized.

between a UA and an MTA is called P3, and the protocol used to communicate between two MTAs is called P1. Another level of protocol is P2, which is actually on top of P1 and is used for formatting the messages being forwarded. Although the messages passed via P1 and P2 are formatted according to P2 protocol, this information is not interpreted by the MTAs, so the P2 protocol can be seen as a protocol used between UAs (see figure 5).

It is very important to understand that the MHS is a model of message exchange used to develop the standard. It is not a description of how a message system must be organized. A message system can communicate perfectly well according to the X.400 recommendation but have a totally different internal structure. Some message systems with many users on one computer may not have any sharply defined user agent in them. They can still communicate with other MTAs by using the P1 and P2 protocols.

Since X.400 will probably be the accepted standard for message handling, a way must be found to handle group communication within X.400. Group communication will probably be implemented by introducing group agents into X.400. A group agent in this context will be similar to a user agent. It will have a name, and it will interpret the P2 protocol information.

The functions of a group agent, however, may be split into several separate modules. X.400 will be extended with a directory system, and the lists of members of groups will probably be stored there. The actual storage of messages belonging to a certain group may be done by special services for filing and retrieving messages instead of by the group agents. ■

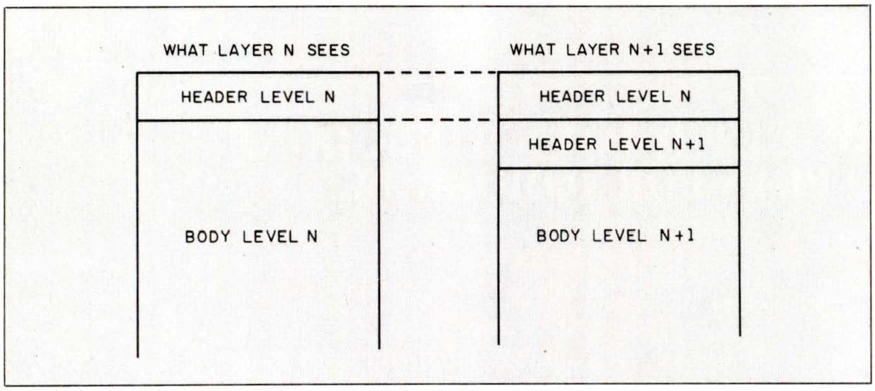


Figure 4: *This figure shows how a new layer (N+1) can be built on top of a lower layer (N). The protocol in layer N is used to forward a message, but what looks like just a body with no structure to layer N is further structured by layer N+1, with, for example, a new layer N+1 header and body.*

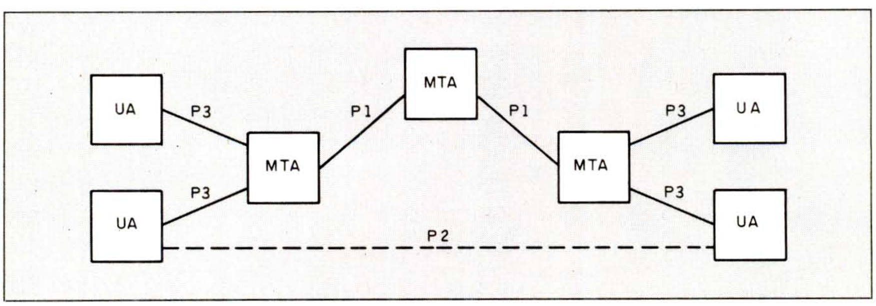


Figure 5: *This figure shows how messages are passed from UAs (user agents) via one or more MTAs (message transfer agents) to the recipient UA in the MHS model. The P1 protocol is used between MTAs, and the P3 protocol is used between a UA and an MTA. The messages passed via P1 and P2 are formatted according to the P2 protocol, but this information is not interpreted by the MTAs, so the P2 protocol can be seen as a protocol between UAs.*

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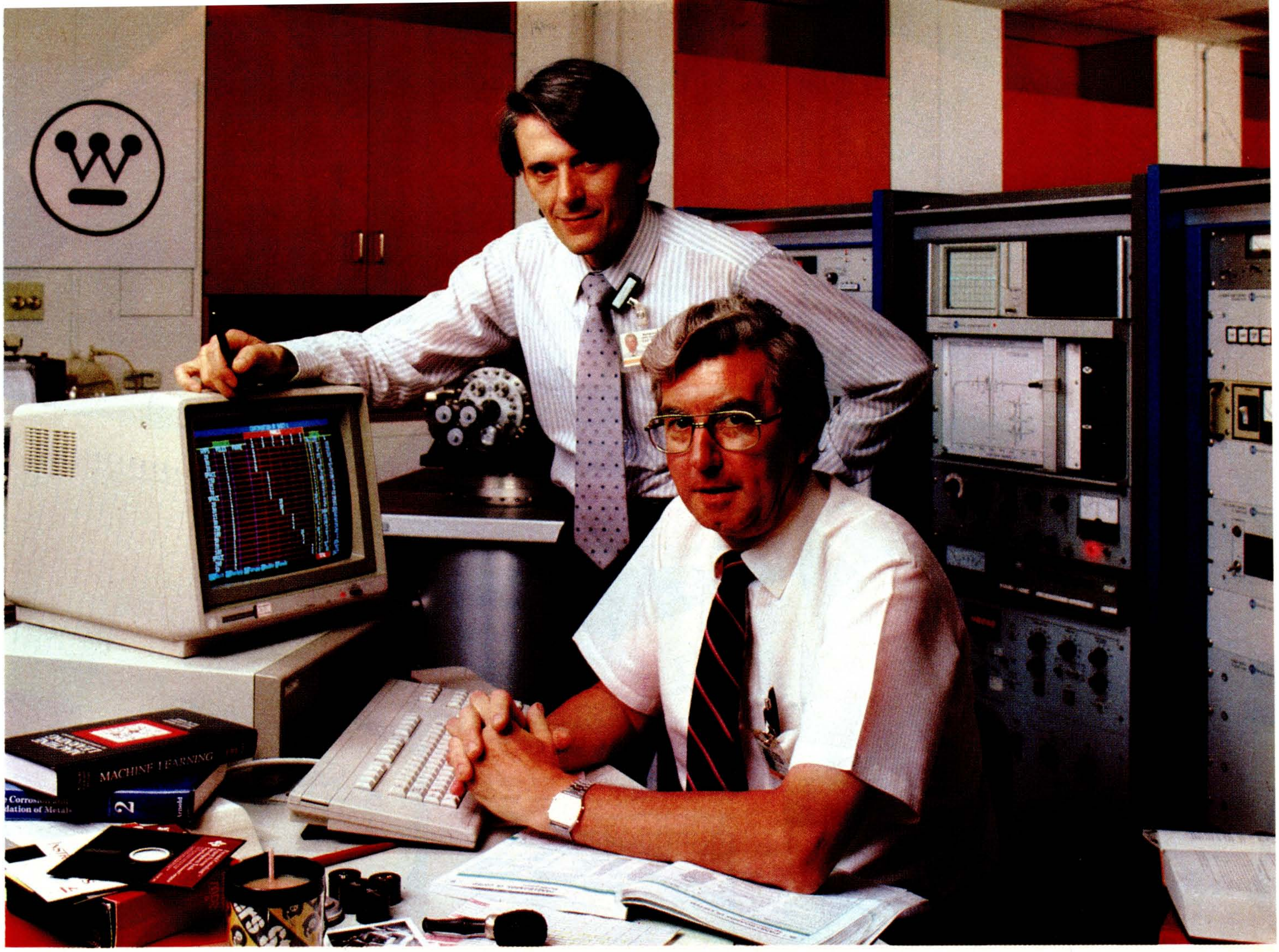
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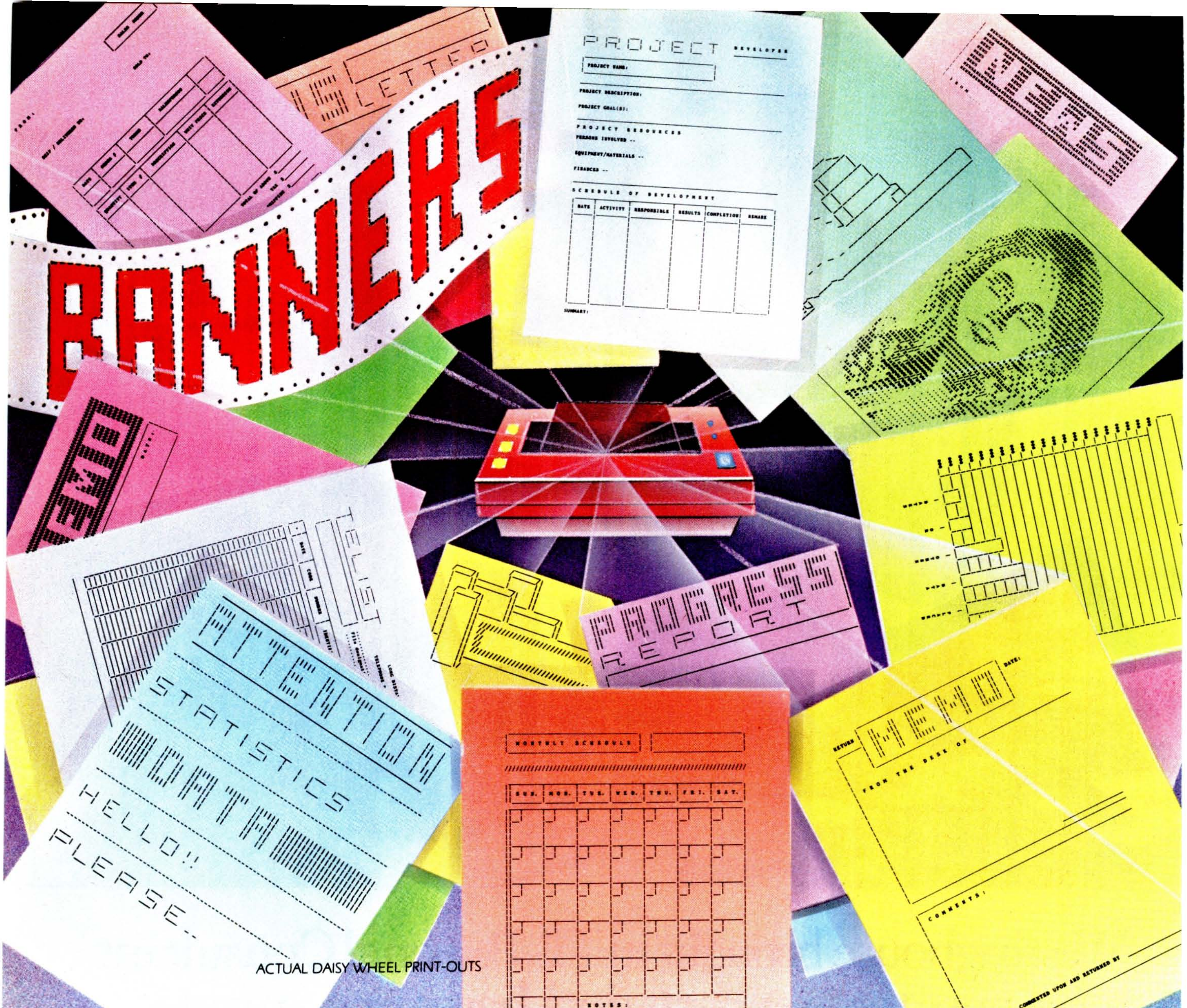
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DATABASE STRUCTURE IN PORTACOM

BY JACOB PALME

A look at the functions that affect database structure

COMPUTER CONFERENCING systems are often more database-oriented than other message systems. Thus, the database structure is an important property of a conferencing system. We will examine some of the functions that affect database structure within the COM and PortaCOM computer-based conferencing systems.

A message can belong to one or more ordered sets of messages. For example, such a set can be the letters to or from a certain person or the messages in a conference. The word *activity* is used for such a set of messages. An activity also has a *name*, a list of users who are *members* of the activity, and a sequential list of *references to messages*. One message can be entered into several activities. Only one copy of the message text is stored, with references from the activities to the message text. Figure 1 shows links between messages and activities containing lists of links to messages.

Every user has a personal *mailbox*, which is an activity containing letters sent and received by that user. A user can also create additional personal activities and sort messages by entering references to them in one such personal activity. A computer conference is an activity with several users as members who normally can both read and write messages in the conference. For example: A certain message may be entered into the three activities "Joan Smith," "COM Experience," and "PortaCOM Development." This message is then available to "Joan Smith" as a letter and to all members of the conferences COM Experience and PortaCOM Development as a conference entry. When someone writes a comment on the message, the comment is sent to all the above recipients so that all who read the original message also receive the comment. The comment is also sent to the author of the commented message if he or she is not a member of any of the other receiving activities. It is also possible to write personal answers that are sent only to the author of the message.

LINKING ENTRIES

The recipient of a message can establish *links* to it. In other words, he or she can "send it along" to other activities such as personal mailboxes or conferences.

Figures 2, 3, and 4 illustrate a user dialogue made up of linking entries.

The recipient links to the new entry can be changed during or after the writing of it. Commands exist for adding and removing recipient links on an entry. Figure 4 shows the use of the !move command, which removes all existing recipient links and adds one or more new links.

MESSAGE SINGULARITY

Under the COM/PortaCOM system, you can't receive the same message twice. A chain of comments is often

(continued)

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sent to the same set of recipients, which could be, for example, two conferences and two personal mailboxes. A user will not see this entry twice even if he or she is a member of both conferences.

Users who do not have their personal mailboxes in a certain COM system can have messages sent to them via message networks such as MAILNET or ARPANET. The recipients' COM conference will appear as a conference to local users and as a mailing list to external users. Note also that, in this case, an external user who is a member of two COM conferences will only get one copy as mailing-list mail.

In ARPANET, there is an unwritten rule that a message should not be sent to more than one mailing list. In COM/PortaCOM, there is no need for such a restriction.

MULTIPLYING RECIPIENTS

In COM a comment is normally sent to all the recipients (conferences and mailboxes) of the commented message. In general, this function works well. In some cases, however, you may wish to send a message to one or more conferences or mailboxes without having them flooded with all of these extraneous comments. This can be done with a special kind of link between the text and the recipient called "single copy."

Comments (by default) are not sent to single-copy recipients of the commented message. The author of the comment can, of course, give a command to also send the comment to these recipients (unless they are write-protected).

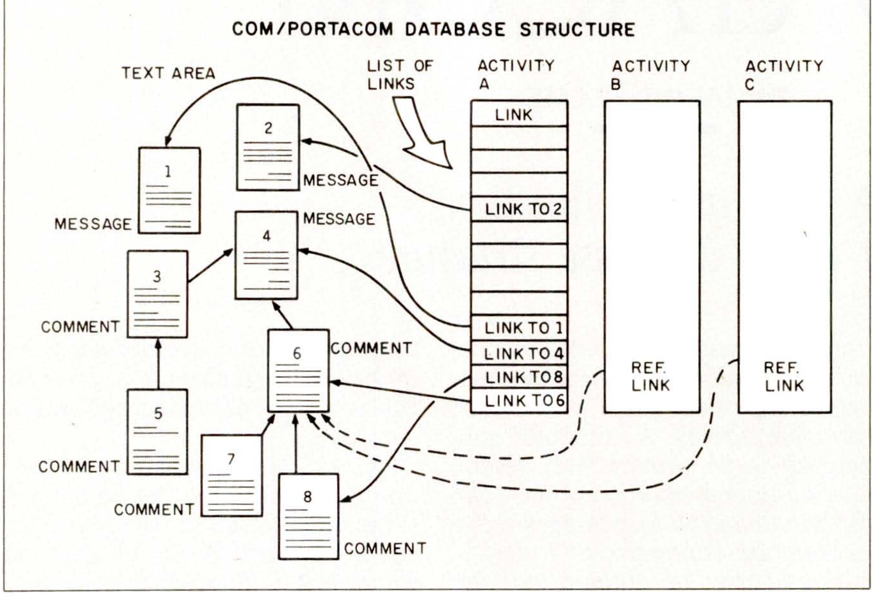


Figure 1: *In the database structure shown here, message 6 is linked to activities A, B, and C. Messages 7 and 8 are comments on comment 6. Activity A contains a list of links that describes the relationship between all the messages in the text area.*

(Text 22545) 85-04-05 22.27 Dennis Jennings Univ. College Dublin
Receiver: Computer networks
Receiver: IBM computers
Receiver: NSIN01 @ RLGB.JNT-MAIL(Paul Bryant)
— Received: 85-04-06 05.02
Comment on: (Text 21135) by Ulf Beyschlag CERN
Subject: BITNET

See my earlier comment.
(Text 22545)

Figure 2: *The user reads an entry, which was in this case linked to two conferences and one personal mailbox, remotely accessible via mail networks.*

TYPES OF CONFERENCES

A COM/PortaCOM conference is categorized by the following attributes:

Open: Anyone can become a member.
Closed: Only the organizer(s) can add new members.
Restricted: Open to one set of users, closed to another set.
Protected: A closed conference, where nonmembers cannot even find out that the conference exists.
Write-protected: Only some can create links between texts and the conference. Note that the restriction is not on who may write texts but who can link them. An editor of a write-protected conference can therefore link texts (written by noneditors) to that conference.
Original: These conferences are most often used for getting a selection of the most interesting items out of other conferences. The original conference will not automatically get comments on entries sent to it.

Whenever a message cannot be sent to a conference because of restrictions for write-protected or original conferences, a *super-conference* can be defined to which the comments are sent. For example, a newsletter may be write-protected, but anyone can comment on the news items. Comments will be sent to a writable conference for comments on the news. I will cite some examples of the types of conferences described

(continued)

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above and show how they relate to specific tasks.

ELECTRONIC PUBLISHING

An author sends a new item to an activity for incoming manuscripts. This is a closed activity, readable by one or more of the editors. They look at the paper and establish a new link from it to the personal mailbox of one or more referees.

The referees' comments are entered into a special activity for such comments, together with a reference link in the database that connects each comment to the original entry. The editor decides to accept the paper (possibly after revision by its author) and then establishes a link between the paper and the activity for published papers, such as the electronic journal itself. This activity is write-protected so that only the editors can link items to it.

```
What do you want to do? (Read) next notice, Quit, Comment (on
entry), (Send a) letter (to), Personal (answer), Other.

- [comm]
Comment (on entry)

Receiver: Computer networks
Receiver: IBM computers
Receiver: NSIN01 @ RLGB.JNT-MAIL(Paul Bryant)
Comment on: Text 22545 (by Dennis Jennings Univ. College Dublin)
Subject: BITNET
```

Figure 3: *The* comment *command starts a new entry, with a comment link to the previous entry and with recipient links to the same entries as the previous entry.*

```
[!move BITNET planning]
Move (entry) BITNET planning
BITNET planning added as receiver

You are at the end of the entry.
Subject: Doing the rounds
[Moved entry]
[!enter]
Enter (it)
17.32 Letter (Text 30767) sent to:
BITNET planning

What do you want to do? (Read) next notice, Quit, Read (the)
rest, Comment (on entry), (Send a) letter (to), Personal (answer),
(Re-)type (the text), Other.
- [type]
(Re-)type (the text)

(Text 30767) Today 17.32 New Userman
Receiver: BITNET planning
Comment on: Text 22545 (by Dennis Jennings Univ. College Dublin)
Subject: Doing the rounds

Moved entry
(Text 30767)
```

Figure 4: *At this point, the user wishes to* !move *the entry (comment on Text* 22545*) to the* BITNET *planning conference. He uses the* !move *command, which removes all previous recipient links from the message.*

SYSTEM DEVELOPMENT

A conference is opened for users of a certain software system. A user in this conference suggests an improvement to the system. Some other users comment on this improvement. The system designers then discuss how to implement this improvement in a closed conference for those responsible for development of the system.

Even though their discussion is in a separate conference, it can still be linked to the original discussion, since commentary links in COM/PortaCOM can cross conference boundaries. When the change is implemented, a comment is entered into the user conference again, commenting on the original proposal and informing the users that the change has now been implemented.

If users ask the system to print all entries in a certain structure of directly and indirectly linked messages, they will be shown only the subset that they are allowed to see. Thus, the ordinary user will be shown only the discussion in the user conference, while the implementers will be shown the discussion in their closed conference as well.

SELECTING MESSAGES

Participants in large public conferences can select messages of special interest to themselves or someone else and link them to special selection conferences. For example, I select those messages that I think my manager should read, and I send them along to him by linking them to his personal mailbox or to a closed conference for the two primary managers of our computer center.

Selected messages can also be sent to public conferences, designed so that original entries cannot again be

(continued)

sent to them; only entries that have been referred there from other conferences can be sent.

TELEX HANDLING

Suppose that you want to introduce a system in which all outgoing telexes have to be approved by certain telex controllers. You can then create an activity for all suggested telexes or, if you prefer, separate activities for suggested telexes, one to be handled by each telex controller.

The telex controllers have the right to move entries from these activities to other activities of messages to be sent as outgoing telexes. The program that transmits outgoing telexes appears to the system as a special kind of human user who takes messages from the activity for outgoing telexes and sends them. In the same way, incoming telexes can be entered into a conference for incoming telexes before a human decides to which activities to move these telexes for handling.

LINKS BETWEEN MESSAGES

COM/PortaCOM also allows links between messages when one message is a comment on, or a reply to, a previous message. These links are also stored in the database and will create a structure consisting of all the messages related via these links.

There are commands for traversing these links. They are used, for example, to find all the comments on the message or for traversing (backward or forward) the whole structure of all the messages linked together. There are also commands to tell the computer that you do not want to read the rest of the entries in this set of messages but that you still want to remain a member of the conference.

DATABASE STRUCTURE

To a novice user, COM/PortaCOM is a system for handling letters and conference entries. The fact that both letters and conference entries are handled by the general-purpose activity concept is transparent to the novice user.

The database structure of COM/PortaCOM does not use a separate storage area for each conference. Instead, the database consists of objects and links.

Text items, personal mailboxes, and conferences are objects. Entering a text item into a conference, sending it to a mailbox, or making it a comment on a previous message entails the creation of a new link in the database. Each object has a list of links to and from it. All links are members of the list of links of both the linked objects, so that a link can always be found starting at either end.

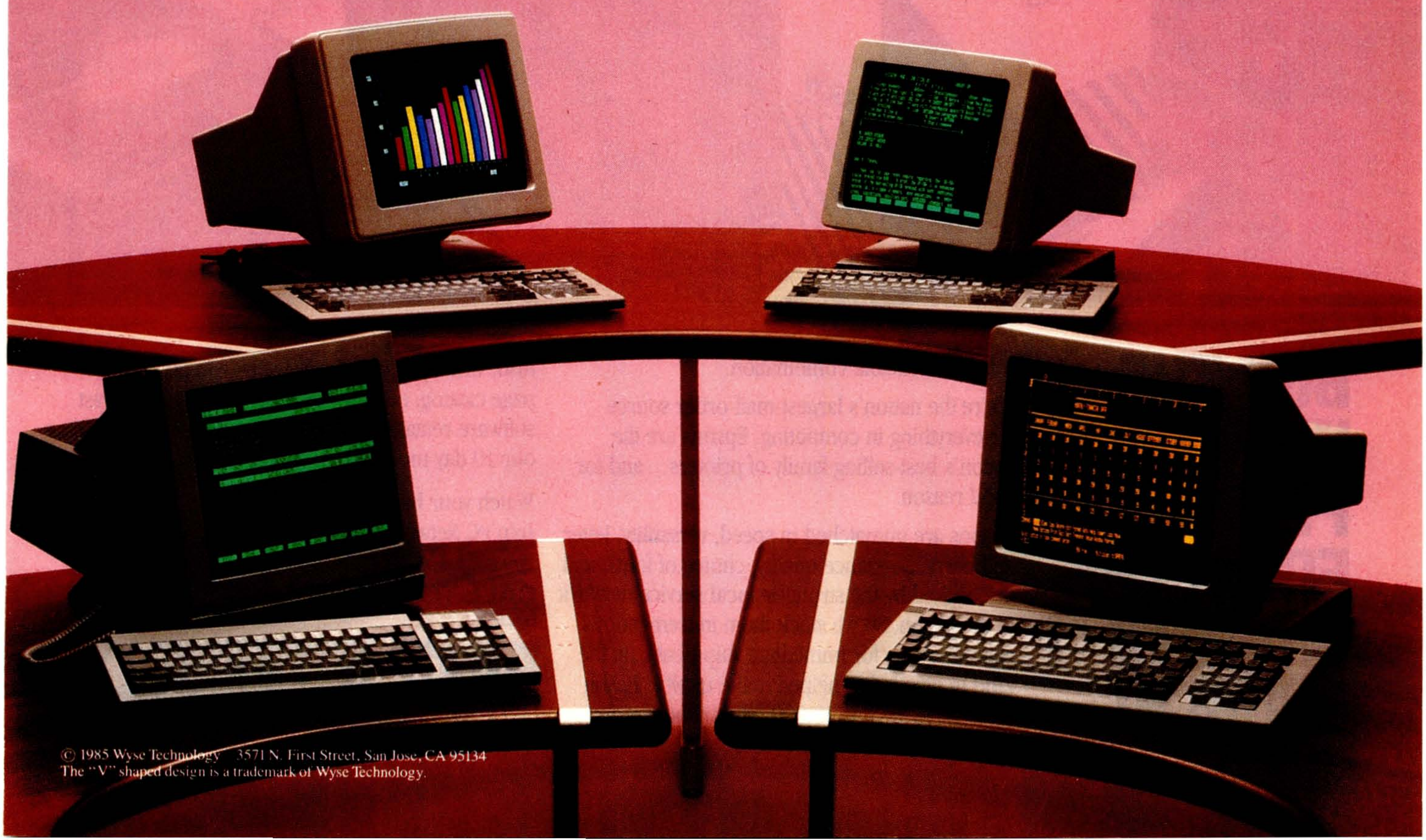
New links can be added, or old links removed, at any time. Thus, the forwarding of a message to a new recipient only entails the creation of a new link in the database, between the text item and the mailbox of the recipient. The removal of a message from a conference entails the removal of a link (not deletion of the text itself, as it may still be linked to other conferences or mailboxes). For example, it is possible to create a link between two text items long after they have been added to the database by saying that one of them is a comment on the other.

A user has the authority to add and remove links to his or her own messages. The organizers of a conference have authority to add and remove links to the conference. The creator of a link has the authority to remove the links he has created. The COM administrator can assume privileged powers to create or remove any links in the database. One of the challenges of designing computer message systems is to find suitable principles for such access rights to further smooth information flow while protecting privacy requirements. ■

Editor's note: The COM and PortaCOM manuals are available from QZ, Stockholm University Computing Center, Box 27322, S-102 54 Stockholm, Sweden.

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Even a distributed chess-playing program could be considered to be an adaptation of raw computer conferencing to a specific task. In a traditional computer conference, a group of people submit short notes or pieces of text to a system that stores and redistributes the information. You can also use such a communication system to transmit the moves of a chess game between two players and their spectators. However, special-purpose interfaces that understand chess shorthand and how to display chess moves would be even more desirable to tailor the conferencing system to the needs of the chess players.

Convinced that such a computer communication system needed to be built, we set about designing one. What characteristics should such a system have? We already had some in mind. But, to the consternation of many of the developers, some of the system's design considerations were premises a posteriori, design points that we weren't able to articulate until after we had seen the consequences of violating them.

Many of the characteristics that set the direction for the system were lessons learned from an earlier conferencing effort, the PALTRY Computer Conferencing System. (PALTRY was so named to ward off criticism of the early system.) Our new system was christened GRANDiose, or GRAND for short. (See the text box "GRANDiose Design Considerations" on page 204.)

VNET: AN ENORMOUS TESTING GROUND

It would be impossible to experiment and test the ideas behind GRAND without getting it into the hands of real users. A suitable collection of such users was available on IBM's VNET system. VNET is a collection of about 2000 major computers distributed among 215 cities throughout the world. The computers are connected together by a variety of means, including channel-to-channel adapters, satellite links, fiber-optic cables, and phone lines. The terminals and workstations of the 200,000 network users are connected to the main computers by channel attachments, 1.2-megabyte-per-second direct coaxial cables, local-area networks, and twisted-pair, dedicated, and dial-up phone links.

The major computers on VNET run various versions of IBM's VM/370 and MVS operating systems. VNET's users include experienced systems pro-

(continued)

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grammers, novice users, computer scientists, secretaries, corporate executives, summer students, manufacturing workers, administrators, and managers. In various combinations and for various purposes, all these people need to communicate.

Because VNET is the principal electronic means by which people in IBM communicate, the conferencing applications must compete and cooperate with established electronic-mail and communications programs. Merely providing electronic mail isn't enough to get anyone's attention.

VNET is a store-and-forward network that can transmit both files and messages (short, about 100-byte, priority transmissions). Hardware and software problems can delay or even lose messages and files. No end-to-end acknowledgments of transmission are built into the basic transmission system, which is based on VM/370's RSCS (remote-spooling control system).

Although this community is an excellent test bed for GRAND, we had to design it to fit into other operating systems and into communications networks with different characteristics. This meant that we had to include the appropriate interfaces so it could run on and communicate with other systems.

THE NETWORK-BASED APPLICATION

If you wanted to write a program to maintain a database about hiking trails, you could write it on your microcomputer. If you gave a copy of the program to a friend, he or she could maintain his or her own database about hiking trails. While you have saved your friend the effort of writing the program, you will both be

(continued)

GRANDIOSE DESIGN CONSIDERATIONS

THE NETWORK

• GRAND users should be able to remain in their normal electronic environment, which includes the operating system, file, profiles, and tools that they have available during normal use of their computers. They should not have to log onto someone else's computer, have all their commands taken by the conferencing system, and be separated from the tools and files that they are accustomed to. To accomplish this, some conferencing-system programs must run in the user's environment to transmit data to the rest of the system.

• You cannot serve all users with one main computer. Even if you are willing to force people to (logically) leave their normal environment, no one computer could support a very large community of users (i.e., the world). Thus, you must distribute the system among a collection of computers.

• You must isolate part of the system from direct user control to ensure that data is secure from unauthorized use, to ensure data integrity, and for system reliability. Therefore, you need to establish server tasks.

• You should be electronically as close to the computer that is providing the conferencing service as possible. Computer users are neither happy nor productive if they get poor performance from their computers; therefore, transaction speed is important. If you use a large computer and if the conferencing data is stored on disks that you have access to, you can get extremely fast service. If, however, your connection to the data is over a T-1 carrier (a 1.5-megabit-per-second telecommunications line), your service is not as good. If you must go through voice-grade phone lines, it's even worse. In some situations your interactive communication must be handled by a series of hops across various communication lines. But the closer you can be, the better.

THE APPLICATIONS

• GRAND must support a variety of communications applications. No single design of a traditional computer conferencing system is well-suited for all users in all situations. For example, the features and functions that a computer conference needs to arrange a Frisbee game among 30 people differ from those needed by a professor to conduct a class.

• Because the tastes, expertise, and practices of different users are quite different, no single user interface is satisfactory. Therefore, you need more than one UIP (user-interface program). To make practical the support of multiple UIPs, GRAND needs a well-defined programming interface for the UIPs to communicate with. This interface must include command syntax and the format and interpretation of application data.

• To authenticate who each user is, run private conferences, and accommodate individual preferences about how users deal with the system, GRAND needs the ability to verify that a transmission comes from where it claims to come from. This allows the system to restrict certain commands to certain people no matter where they are. This task becomes more complex because the system is distributed throughout a large network of machines.

• The application programs within the conferencing system should be independent of the user communications programs. If users remain in their normal environments, they are unlikely to all choose the same method of communication with the system. Therefore, the applications must not contain any code for user communications.

• You don't want either central or completely independent server operation. However, the parts of the system should work in concert rather than as a collection of independent domains. Since we are unwilling to impose central control, this task becomes a difficult communications problem. To solve it, we treat managing the system as a GRAND application. Thus, even the operation and maintenance of GRAND become a specialized conferencing application.

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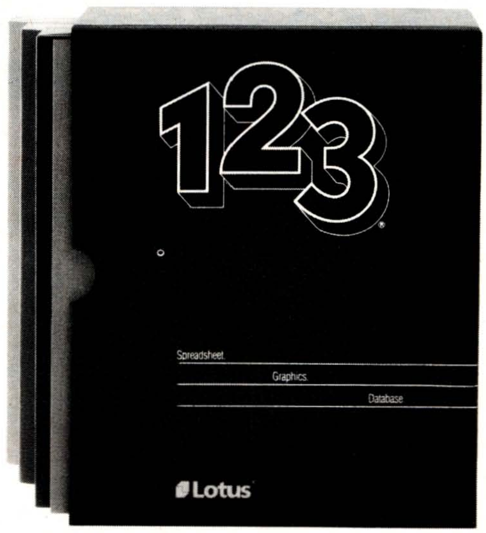
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If you wrote the database system on a time-sharing system, or if your microcomputers were connected together, you could maintain a common database. You could both benefit from the work that each of you does. This is a fundamental improvement in the system's usefulness.

If you gave this program to another set of people on another time-sharing system, they could create their own database. But the two databases will differ. If these time-sharing systems or networks of microcomputers were connected together, the database programs could create one massive, common database from which all the users could benefit.

For these reasons, applications should be designed so that they treat the entire network as a uniform collection of users; you should not write them with one microcomputer or one time-sharing system in mind. The power of microcomputers is great, but it pales in comparison to the potential of networks of computers, large and small.

THE NETWORK APPLICATION MANAGER

Once you accept the value of network-based applications, how do you design them? Should each hiker's database, chess-game manager, news-distribution system, program-library manager, mail system, and conferencing system be independent? All these systems have a large overlap in the functions that they need in order to work. Rather than duplicate the effort each time a new application comes along, you should distill their common parts into a support system for all the applications. This network application manager (NAM) would provide the basic communication and support services that the applications need in order to maintain and distribute their data and to communicate to the users.

By providing these services, the NAM reduces the effort required to develop new network-based applications. Thus, applications that previously were too costly to develop have become cost-effective. This is an ordinary benefit of standardization and careful modular design. The virtue of establishing a network of servers that supports many applications is that the overhead cost—both in terms of computer resources consumed and administrative and operational burden—of supporting the applications in the shared system is less than the cost of operating all the applications as separate systems. Thus, still more possible applications become practical. One of our challenges is to figure out what sorts of heretofore outlandish computer uses are now reasonable.

THE GRAND DESIGN

How did we decide to organize our system? The proper choice of interfaces between parts of the system was critical to its survival as it grew and matured (see figure 1). The real work is done by the servers. A server is a task that waits for a user request to come in, interprets its commands when it arrives, and then waits for the next request. Typically, servers maintain local copies of databases and communicate to users and other servers. They treat each other as peers; there is no one server that is master of all.

Servers are sprinkled around the network so that transmission delays between the user and the local data stores are not long. Most other conferencing systems rely on only one server. In these systems your terminal is connected directly and exclusively to the conferencing system. This system design is easier because you don't have to maintain a distributed database. However, it rules out having a large number of active users and leaving them in their normal elec-

(continued)

tronic environments.

You don't need to make all applications available at all servers. And you don't need to duplicate all conference databases at all servers. These matters are specific characteristics of the applications rather than architectural requirements of GRAND itself.

YOUR RELATIONSHIP TO THE SERVER

If you are sitting in your own environment and the servers are off somewhere else talking to each other, how do you get anything done? When you want to use some application that uses the server network, you invoke a user-interface program (UIP) that figures out what you want and, if necessary, sends a command to the local server. Because the UIP runs in your environment, it isn't protected from you. As a matter of fact, you are encouraged to develop your own UIPs if they would better suit your needs and preferences. The server is out of your direct control, so it can do the testing required to ensure the security of the server network.

You may select any UIP you wish to communicate to the servers. Your decision may be dependent on personal preference, degree of experi-

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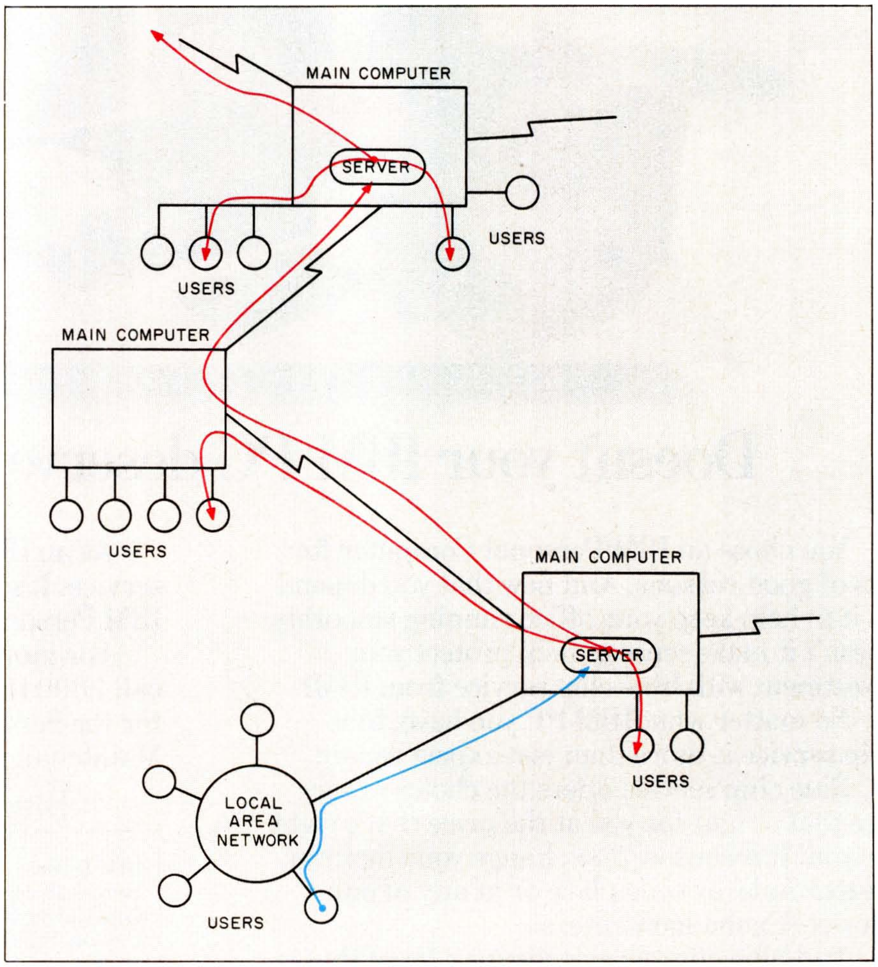
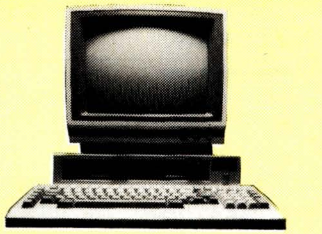


Figure 1: *GRANDiose server network. Some of the main computers have servers in them, and some don't. The user workstations can be microcomputers or terminals. The blue line represents the transmission of a news bulletin over an LAN to the nearest server. The red lines from the server represent the transmission of notification of the news bulletin to various users and servers.*

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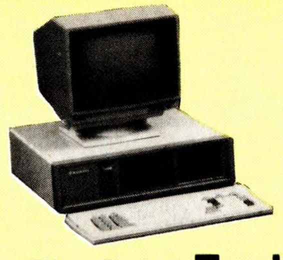
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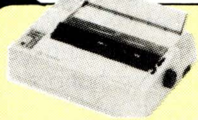


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ence, and choice of editors. All of an application's users do not need to be using the same UIP; they only need to be using UIPs that know how to deal with the particular application that they are using.

To reduce the complexity of writing UIPs, there is a service routine that provides a standard way of finding and communicating with the local server. This lets you change the communication techniques without affecting the UIP.

In a GRAND Style

One of the most important things we learned from PALTRY is that there is no one right way of doing something. Depending on the application and the needs of the users, you may need different *styles* of doing a particular task. This leads to the concept of style programs, interchangeable programs that perform well one style of doing something.

In order to notify you of some news, we need notification-style programs, or NSPs. If a conference wants to notify an ARPANET user of a new entry, it might be appropriate to package the new entry with an RFC822 (ARPANET mail-format standard) header, with its "To," "From," and "Subject" lines and send it off. If you usually log on the very machine that the server is on, then sending you mail about a new entry may be unnecessary. In this case, you may prefer to have a message written to your terminal telling you to look at some file for the new entry. Both are reasonable ways of notifying you. Therefore, both methods are written into NSPs, and you select the one you want from the library of NSPs.

In addition to NSPs, other system functions that may need to be tailored to match the preferred way of doing something are broken out from the basic kernel of the system. These functions include things like conference-style programs (CSPs), arrival-style programs (ASPs), and user-interface-style programs (UIPs). See figure 2 for a diagram of how these functions interact.

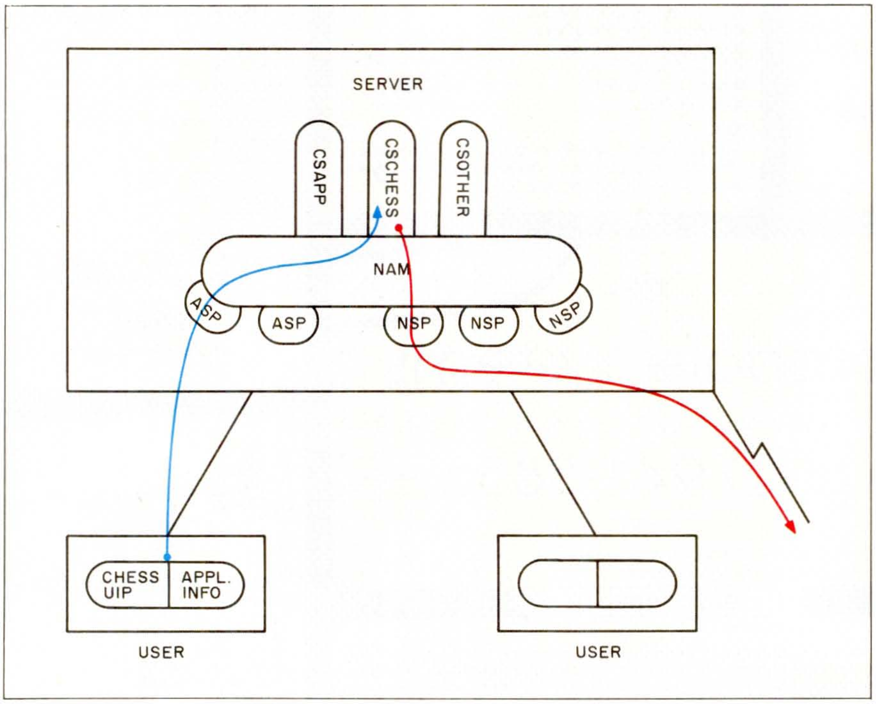


Figure 2: GRAND*iose server internal organization. The* NAM *routes commands to the* CSPs *that contain the application-specific code. The* ASPs *and* NSPs *transmit and receive information to and from the server. The* UIP *exists within the user's sphere; half of the* UIP *communicates with the server, and the other half interprets the application-specific information. The blue line from one user represents the transmission of a chess move from the* CHESS UIP *through an* ASP *to the* NAM *and on to the* CSCHESS *application.* CSCHESS *then forwards the move, via the red line, through an* NSP *out over the network.*

The Design of a Server

Lopping off all the functions that need tailoring leaves the common part of the system, the NAM. Its function is to wake up when something needs to be done, perform various functions, and pass the request, along with any information about its context, to the program that actually does the work. The NAM finds some input, figures out who sent it, and proceeds to parse the command and execute the request. Certain common commands are processed directly by the NAM. For example, the NAM verifies that requesters are who they say they are before it honors their requests. A request usually names the application, or *conference*, that it is addressing. Based on the conference name, the NAM invokes the correct program to handle the request and passes the remainder of the request to it for processing.

The Conference-Style Program

The program that processes all requests directed to a particular conference is called the CSP. Its scope is any matter related to the application's function. Other parts of the system merely provide services to the application, but none infringe on the CSP's ability to define what the application does. Typically, the CSP manages a database of its choosing, honors commands of its choosing, and transmits data to users and other servers. It also determines which users may execute which commands. Of course, if the CSP doesn't make a good choice about what it's going to do, it won't be a very useful application.

For example, CSAPP, one of

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GRAND's CSPs, implements rather ordinary computer conferencing as its application. It accepts the commands ADD, DELETE, REPLACE, GET, JOIN, LEAVE, ADDTOPIC, and DELTOPIC. The database it maintains includes files that are accumulations of things that users have added and control files to tell it who is allowed to do what to each of the other files. Imbedded in CSAPP are certain decisions about how it plans to maintain its distributed database and what rules it has about how people can manipulate the data.

If users running other conferences like CSAPP, they can create another instance of a CSAPP conference. If they feel strongly enough that they want their conference run differently, they can develop another CSP that does things the way they think best. Thus, several different conferencing applications, tailored to the needs of the users, can coexist on GRAND.

Of course, another application, such as the chess-game manager, would have vastly different assumptions about the way to manage its conference, but it would have roughly the same general organization.

At some point, the CSP is likely to need to communicate to its users. However, this is a very complicated task. Each CSP may have to communicate to users and servers on different types of machines, running all sorts of operating systems, connected to the network in strange ways, and having the most incomprehensible preferences. Rather than having the CSPs be aware of all the appropriate means of communication, the NSPs handle that function.

NOTIFYING USERS

Notification-style programs are another group of programs that the NAM calls on to honor requests from the CSPs. The NAM tells the NSP who to notify and what to tell them about; beyond that there are no limits to what the NSP can do. Typically, the NSP sends mail or a message. Some NSPs just record the fact that there is new information and that you should check the database to see what it says. Some NSPs do things, such as send the information by telegram or print the information on paper (for those people who don't routinely connect to the network). NSPs can also serve as the gateways to GRAND servers on other networks and between the GRAND network and other conferencing systems and applications.

The logical counterpart of the NSP is the arrival-style program. Usually, a server receives GRAND commands in their correct format. In order to handle input from systems that do not produce GRAND-format commands, the server lets each ASP check any in-

(continued)

coming data for a recognizable format. If an ASP recognizes the format, the ASP accepts the data, converts it into GRAND-format commands, and passes it along to be processed normally. Using combinations of ASPs and NSPs, you can connect GRAND servers to existing non-GRAND applications like single-machine databases and other networks.

An Application Example

What must you consider to design an application for GRAND? See the text box "A GRAND Application." One rather conventional GRAND computer conferencing application is news distribution. In this conference, one person, the person who writes and edits the news items, can write to the conference, while a large number of people can listen. Many of the details of how this conference works were set up for this application; if you have another application in mind, or even another way of managing this application, you can probably accommodate it by changing the control information for the conference or, if necessary, by modifying or replacing the CSP or the NSPs.

Let's say that some hot news just occurred and you want to communicate this to the subscribers of your conference. You invoke your favorite UIP, suspending the other work you are doing. After entering the text of the bulletin, you enter a command to transmit the data from your virtual machine to your local GRAND server. The UIP prefixes the text of your entry with control information that identifies you to the conferencing system, indicates that you are addressing the News conference, and indicates that you are adding a news bulletin. When the server receives the request, it verifies that the request came from you. It then passes the command to the CSP that manages the News conference, which determines that you are permitted to add news bulletins and processes your request.

Processing the command to add a news bulletin consists of adding the bulletin to the local database and then notifying all the conference subscribers. To notify the subscribers, the CSP goes through its list of subscribers and invokes the NOTIFY program once for each subscriber. NOTIFY looks into the subscriber's profile and runs the NSP that it has selected, passing the NSP a pointer to the subscriber and another to the news bulletin.

There are no restrictions on what an NSP may do to notify you. Typically, it sends you a file containing the news bulletin. Some NSPs send immediate messages containing the news, some print the news on printers, and some just add a pointer to a list of things that you should look at sometime.

Among the list of subscribers to the News conference are some other servers. In the same manner that you are notified of the news, the NSPs for the servers are run, and the news bulletin is transmitted to them. Typically, a server has the news bulletin delivered to it in a file over VNET with the same sort of control information your UIP added to the entry. When the bulletin arrives at the other servers, they go through the same process, updating their own databases and notifying their News subscribers of the news.

Depending upon the manner of notification that you have selected, you do different things. If you are logged onto a machine that has a server that maintains at least part of the News database, you can link to the disk that contains the data and browse it by using any of a battery of editors, utilities, and other UIPs. If you are on a machine where no local copy of the data is maintained, you may have the data sent to you in a file. You would invoke some program to see the news, either using a standard mail reader or a GRAND UIP especially written for the purpose.

It may take only a few seconds between the time that you press the button to transmit the story and the time that NEWS subscribers are reading the story. Barring network problems and unusually long delays, news on GRAND is usually available around the U.S. and Europe within 10 minutes.

The Serve Conference

Developing, maintaining, and operating the network of GRAND servers is a big communications task. Various commands, programs, and data must be transmitted between certain people and servers around the network. The details are quite complex. We

(continued)

A GRAND Application

The common parts of GRAND should not limit what an application can do. In addition to the design decisions that you would normally make when writing any computer program, as a CSP developer you need to consider the following points:

- Should you maintain the database at one server, some servers, or all of the servers? If the cost (in terms of money or time) of transmitting the data as needed is greater than the cost of maintaining the data at more than one server, then you should probably maintain multiple copies.
- How do you want to maintain a distributed database? If you have more than one server with write access, this is difficult to do well, if possible at all. (Most attempts at maintaining distributed databases require complicated and expensive locking arrangements that make them unpalatable.) Fortunately, most applications do not require solving this problem.
- What if you don't have local access to the disk containing the data you need? For most applications, this is not a problem because the CSP can easily send it. However, if you need access to a great deal of data, the server can't send you the entire database. The CSP can, however, do a search for you and send you the result. The UIP checks to see if it has local access to the data. If so, it does the search. If not, it sends the request to the server to do for you. In either case, you don't have to know how your request is being honored; you just get the result you asked for.

decided to use GRAND itself to manage this communications task, so we developed a special CSP to manage the Serve conference.

One special feature of GRAND is the GRREP function. If you need to correct a bug or add a new feature, simply connect from your microcomputer to one of the mainframes on the network, invoke your favorite editor, edit the errant program, and execute the GRREP command. GRREP is a special-purpose UIP that can install a program on GRAND.

Unless you are accessing a copy of a program that is maintained directly by the GRAND server, GRREP saves the file you have edited on your disk and transmits the edited program to the local server. GRREP then asks you to describe the nature of the changes that you have made to the program. Finally, it transmits the description of the changes to the server. (If you *are* accessing a copy of a program maintained by the GRAND server, GRREP doesn't have to save the original file, because the server already has it.)

The server verifies who you are and passes your input command to the CSP that manages the Serve conference. That CSP verifies that you are allowed to replace that program on the server and replaces the old version with your new one. The previous copy of the program is saved, on the chance that you made a mistake, and the fact that you changed the program is recorded in the journal log.

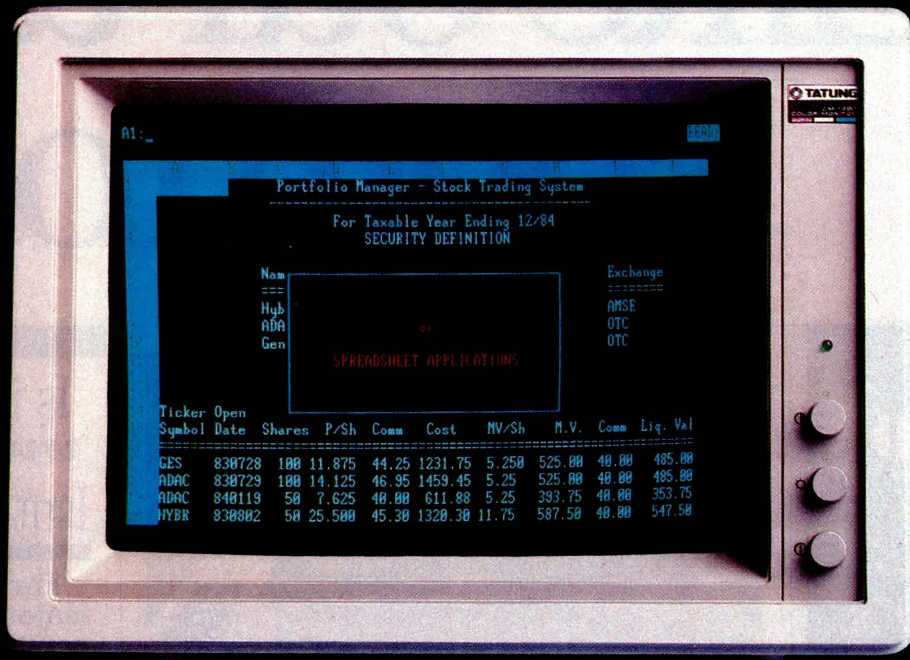
With the new program in place, you issue the commands to test out the new code. You can have the server trace the execution of the program and send you the results. When you are satisfied that your change is correct, you can issue another command to the Serve conference to transmit the new version of the program to all the servers in the network.

Each server receives the files, updates its copy of the program, makes appropriate journal entries, and notifies the appropriate operators of the change. GRAND manages this without interrupting any server's operation. Using the Serve conference we can develop and operate the entire system or parts of it from anywhere.

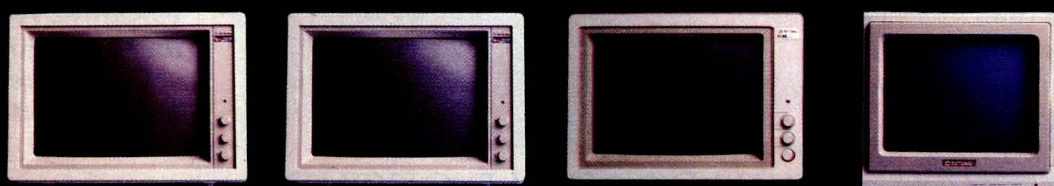
CONCLUSION

The ultimate goal of our effort is to make possible the development of computer applications that can be used throughout the network. The system should be flexible enough to accommodate the different needs and preferences of various users as well as the different needs of the applications. We don't profess to know the right ways of doing everything. GRAND's flexibility lets us try out new ideas with relatively little effort. ■

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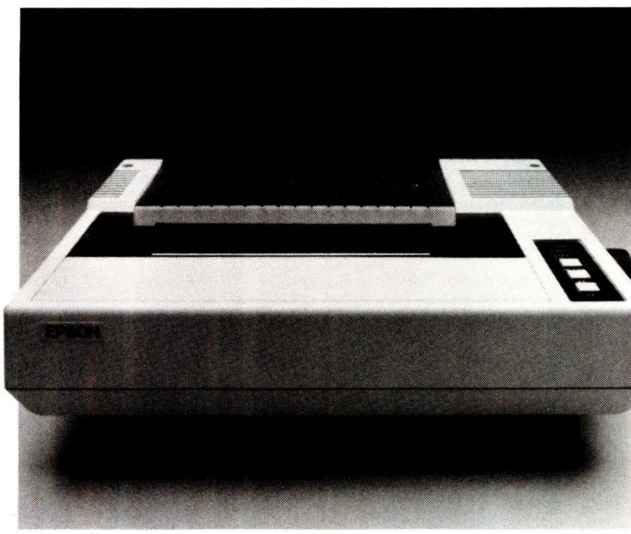
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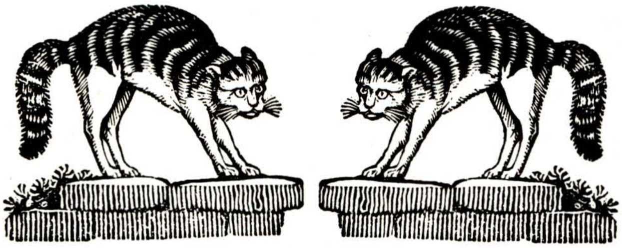
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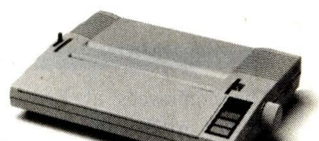
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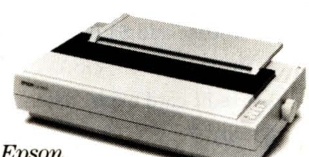
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fib	43	58	46	109	—
deref	14	13	—	10	11
matrix	22	29	27	28	29

1. Computer Language, Feb., 1985, p. 79. Reproduced with permission.

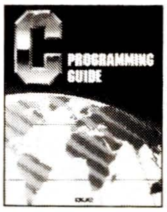
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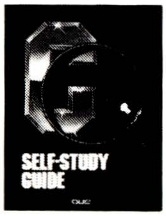
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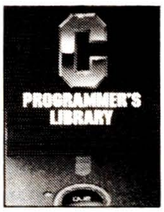
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STORAGE ARCHITECTURES

BY ALASTAIR J. W. MAYER

Their implications for conferencing systems

A COMPUTER CONFERENCING system can be looked on as a special case of a database where the entries consist mainly of variable-length text messages plus associated information about who wrote them, when, and in what context. The choice of file and record structures, or "storage architecture," can have profound implications on what can be implemented easily at the user-interface level and, indeed, on how the messages relate to one another.

When my colleagues and I sat down to design the conferencing system that would become known as CoSy, we did not immediately start worrying about file layouts, record structures, and the like. We started thinking about how the user would view and use the system and then worked backward from there. Of course, the design process is never quite that simple. We had to go through several iterations, because something that we'd thought might be a great idea at the user level turned out to be impossibly complicated to implement but could be done easily with a small change to the user interface.

Still, this was just a prototype. However, in a system of this sort, the files created with the prototype tend to get inherited by successive generations of the software. Think how annoyed users would get if the old conferences became unreadable whenever a change to the software was made! (Indeed, one of the very first conferences on the prototype, for discussion among the developers and test users, was still going strong a year later when the software was well into its second release and on its third hardware home!)

Thus, the organization of the information (the storage architecture) in the system can have profound implications to later development of the software. You can't just say, "Well, with version 4 we'll go to a totally new file organization," because then conversion programs will need writing, and some of the imaginable conversions may not even make sense (because certain necessary data was never stored in the original files).

In this article I'll discuss some of the trade-offs involved in deciding how to store conferencing-system information. Since I am responsible for most of the detailed design and the coding of the University of Guelph's CoSy system, many examples will come from that. I'll make some comparisons with other conferencing systems (COM, for example). It is not the specifics (of any particular conferencing system) but the implications and limitations of certain designs that are important. These designs may be considered hypothetical.

I had to decide whether to approach this subject from the top down, starting at the user-interface layer or at least the general file-layout layer, and working down to character coding. Or I could start from the bottom up, deciding how to store characters in messages. Good programming practice is to start at the top and progress downward. One of the first decisions was to use UNIX to develop the system. (UNIX doesn't care what a file contains; it is just a stream of bytes.)

CONFERENCES

The top level of organization in all conferencing systems is obvious: *conferences*. All conferences can be viewed

(continued)

Alastair J. W. Mayer (University of Guelph, Institute of Computer Science, Guelph, Ontario, Canada N1G 2W1) is the author of the CoSy conferencing system.

as structures in their own right. On all systems that I am familiar with, a conference contains a collection of messages (which may be further grouped or structured), together with information about who reads or contributes to that collection (or has permission to).

Also associated with conferences is descriptive information, such as the date the conference was created, a short narrative about the purpose of the conference, and so on. Another type of data associated with a conference is the user ID of the person who is allowed to manipulate the conference in some special way, such as adding or removing participants, messages, or groups of messages (this person is usually referred to as the conference moderator). Information about which messages have been read by particular participants (stored to simplify the presentation of new messages to the user) can be viewed as being conference information. This information can also be treated as *user* information belonging with other data about the user.

We've now come to the first decision point. Does "last message read" information belong in a user-related file or in a conference-related file? Here the term "file" is used loosely; a conference "object" may be made up of several files.

Keeping "last message read" in the conference file simplifies such housekeeping operations as adding a user to a conference (or removing one), removing messages, and so on. On the other hand, an element of redundancy is lost by doing this. If such information is stored in user files, then the system becomes easier to reconstruct should something catastrophic happen to a conference file. (I am thinking more of a software error than a hardware problem here, since full backups are done regularly.)

In CoSy, I chose the latter approach, with some redundancy. Each conference has connected with it a list of the members of that conference, and each user has a list of the conferences to which he or she belongs. Should problems occur, one list can be rebuilt from the others in the system. The "messages read" information is kept with the users' lists. Since this information changes often when a user is signed on and reading or writing messages, this list can be read into memory and continually updated without the disk I/O (input/output) that would be needed if this information were kept with conference files. COM and Telecenter also keep this information in the user files, although the details are significantly different (see references 1 and 2).

CONFERENCE-SYSTEM HIERARCHY

Are "conferences" really the topmost level of conference-system architecture? In any type of business environment there have to be classes of conferences. For example, there should be public or open conferences (or forums, if you prefer) that anyone can browse through or contribute to. Indeed, these are usually the most popular and active ones on the system. There are some discussions, however, that should have restricted (closed) access, although you may want to post their existence so that someone who is interested enough can ask to be invited in. Finally, there are conferences that are closed and which the participants have no intention of letting anyone else into. Such a conference might be a private conversation between two or three people, for example. These unlisted conferences are called "confidential" in CoSy parlance.

We knew at the outset that we would want these three classes of conferences. But all three classes can be treated alike (indeed, a CoSy conference can be switched from one class to another). Thus, there is no real "class layer" above the conference layer. Rather, information is logically included within each conference according to conference type.

Another upper layer is "groups" of related conferences. This is an especially useful concept in an application where there are many open conferences (electronic publishing, for ex-

(continued)

ample). The new user is likely to be a bit bewildered by all the available choices, so some method of grouping conferences is desirable. There might be a languages group, an operating-systems group, and so on, each group comprising a number of separate conferences.

Had we thought of this idea at the beginning, we would have been tempted to incorporate it into the file structure, using UNIX's directory hierarchies. This concept, however, did not arise until later, as the number of active conferences grew and the group structure became more virtual than real. A group is really just a named list of conferences, nothing more. This, I think, is preferable to the group/conference hierarchy that we might have implemented, since it permits users to transfer easily from one conference to another without worrying about whether they are crossing a group boundary or not.

On the other hand, there are advantages to having some sort of group boundary in terms of giving users easier control over how they read their messages. The differences are better appreciated if you've actually used CoSy. However, I'll try to explain.

In CoSy, each user has a list of conferences to which he or she belongs. CoSy provides a simple mechanism

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for reading messages from these conferences. Just hitting the Return key will cause an automatic search for the next unread message. The search starts within the conference topic you are already connected to, if any, and continues on to the other topics in the same conference (if the user has read all the messages in the initial topic). If all the messages in this conference have been read, the search starts at the top of the user's list of conferences and progresses down through it, stopping at the first unread message.

With few conferences or a relatively quiet system, this is perfectly acceptable. An "order" command is provided so that users can rearrange conferences on their lists, to place higher-priority ones at the top. However, in a situation where you are a member of many conferences and there are many other people on line at the same time who are adding messages, you can sometimes find yourself "ping-ponging" from one conference to another as messages get added elsewhere while you are reading the messages in one conference. It would be nice to be able to group conferences in such a way that the ones you use for work, say, are distinct from those you participate in out of interest, so that you are not distracted by messages in lower-priority conferences. This is not really that significant a problem, as the "order" command can deal with this, although it does illustrate that any feature can have both positive and negative effects.

Telecenter has no concept of groups of conferences in that sense, but it does use the UNIX file permissions to define open and closed classes of conferences. COM (and most other conferencing systems) also allows open, closed, and unlisted conferences. Neither of these systems support the concept of named groups of conferences, however.

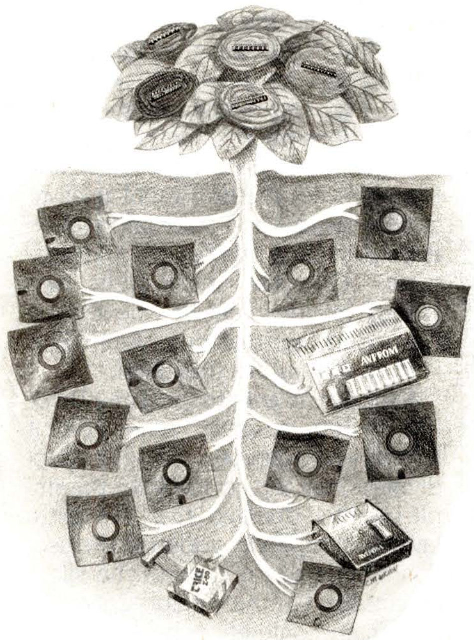
BELOW CONFERENCES

Not all conferencing systems have a named level below conferences (such as "topics"). They just start right in with messages, although there is usually some structure to the way in which messages are presented. It seemed logical to us, though, that within a given conference there should be the option of dividing discussion into several areas. One analogy is of agenda items at a face-to-face meeting, although with a computer conferencing system, users can carry out discussion on all the agenda items almost simultaneously.

This is easy to do in UNIX. We just implemented each conference as a directory and the topics as files within

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that directory. (I am simplifying slightly.) Going this route had the bonus of making it easy to add attributes to a conference. Another file could be added within the conference directory. The "UNIX-ness" of all this is transparent to the users, who are never exposed to the raw system.

COM does not provide for this hierarchical conference/topic structure. However, the method COM uses to store messages and other information does provide a number of other features. COM does most of its own storage management, relying little on the underlying operating system. This is discussed more fully later.

Although Telecenter uses the UNIX file system—indeed, relies on it heavily—conferences are not subdivided into topics. Possibly the implementers decided that the extra layer of complexity added to the user commands was not worth the slight advantage. On the Guelph CoSy system, many conferences have only one topic, but some have as many as seven, eight, or even more (there is no inherent limit).

PARTICIPATE

The PARTICIPATE conferencing system (PARTI on The Source) uses a different structuring concept altogether and allows each note in a conference the potential to become the root of another conference, building into a many-branched tree structure. The comment structure of messages within a CoSy topic is similar to this, although the branches remain within the topic and a member of the conference has access to all messages in all branches. (A new conference can be formed from them by copying, if desired.)

THE MESSAGE LEVEL

Now we get down to the real meat of a conferencing system: the messages. It is also here that the differences in implementation really start to show up. In Telecenter, for example, each message is a separate UNIX file. These are grouped into conferences following the normal UNIX directory system. A message can be shared by two or more conferences by using UNIX file-system "links," although there is no user-friendly way to do this.

Given this implementation, several things become easy and tempting. For example, a user's new messages are links stored in the user's directory, connecting to the conference messages, and they are unlinked as they are read. This makes for a system that is easy to construct, using existing UNIX commands and writing the Telecenter commands as UNIX command files or execs (called "shell scripts"). It reportedly took Mike Pearson about one week's programming effort to get the first version of Telecenter running. (The CoSy prototype took about six or seven weeks' worth of programming plus, of course, design, documentation, and testing time.)

The disadvantages to this approach lie in the storage overhead of all those separate files, as well as the program overhead necessary for command scripts. While excellent for prototyping, this method sacrifices some speed and is portable only to other UNIX systems.

As mentioned briefly above, COM does all its own file management and indeed is almost an operating system unto itself. COM reserves several large chunks of file space and then manages its own "internal" file system using this space. Several of these files are used to store such information as numbers of objects, their names and their addresses, information and details about users, etc. (in effect, a directory).

The most interesting of these files is the TXT (for "text") file and its associated OBJ and DIR files. Actual message text and some information about author and creation date is stored in the TXT file. More detailed information about the text (rather than the text itself) is stored in the OBJ and DIR files, including pointers linking comments together with the texts they comment on (CoSy handles these comment pointers differently).

All the relevant information about record lengths, position in file, and so

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on, is maintained by COM. Additionally, COM buffers file blocks in and out of core. If a user accesses a particular message, COM first checks to see if that block is already in memory. The use of UNIX provides this buffering automatically for CoSy and other UNIX-based systems.

COM's ability to handle files and messages allows a very flexible file structure. As in Telecenter, all COM messages are separate entities that are linked by pointers to wherever they belong. Thus, a COM message can be in several conferences and several people's mail baskets and need not be replicated. This saves storage space and obviates the complications of "copy" and "file" commands to manipulate messages. A message can be copied to another conference, or as mail to another user, just by manipulating links.

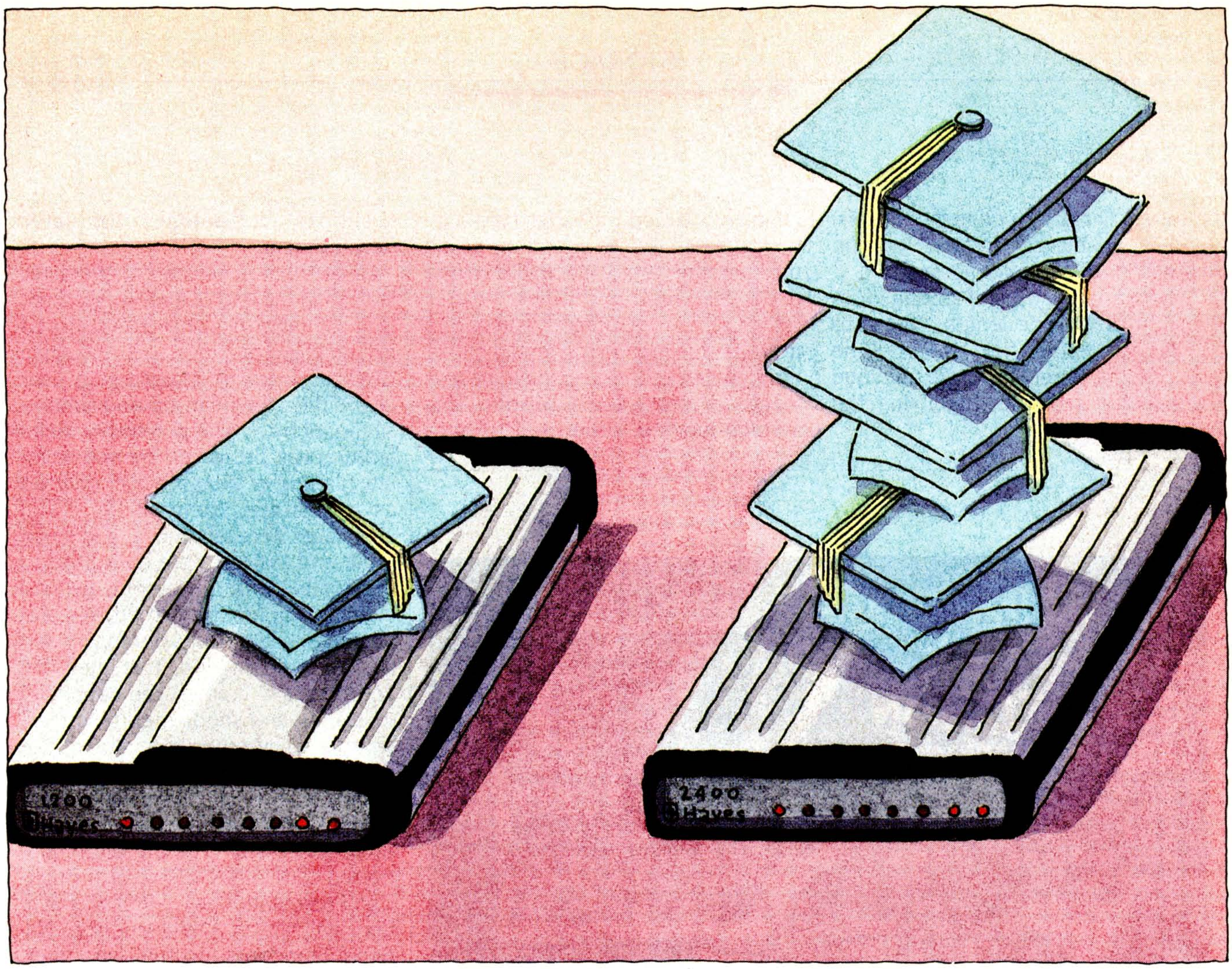
On the other hand, the development of COM required great effort since, in effect, a major part of an operating system (storage allocation, file buffering) had to be written. An early version of COM was about 30,000 lines of DEC-10 assembly language, and the design-stage estimate for PortaCOM was 90,000 lines of Pascal. The CoSy prototype was about 3000 lines of C, excluding the editor; it is now about 12,000 lines, including the editor.

COM also imposes some structure on the content of messages that is not present in CoSy or Telecenter but may be present in other systems. For example, most nonprintable ASCII characters are stripped off when text is input, and lines are restricted in length. Lines are formatted to the user's desired line length on output, up to a maximum of 76 characters. This is perfectly acceptable, even desirable, in a conferencing system consisting solely of text messages. However, it precludes the later incorporation of graphics messages (messages containing graphics codes or information) without some serious reprogramming.

CoSy compromises by doing its own storage management within a single topic, but it falls back on the operating system's facilities for other functions. Thus, a topic is a single file containing the text of messages as well as associated information, such as the author of the message, the date and time written, and pointer information linking comments to the original message on which they comment (this pointer information is stored in a separate file in COM).

In CoSy, a topic file can be viewed as being made up of variable-length records, consisting of a fixed "header" portion containing data about the

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message (including comment pointers) and a variable-length "text" portion containing the actual message.

There are two ways of storing information of variable length. One is to include a "length" field as part of the record; the other is to have a unique terminator sequence signifying the end of the record.

Since I needed a header field anyway and wanted to speed up scans through the topic file (by doing a direct disk seek to the next header rather than reading sequentially through the intervening text), I chose the former method, encoding the text length as part of the header. This storage method turned out to have significant advantages for later development.

Since there is no special character indicating the end of a message, there is no limitation on what data is stored in a text field of a message. And since UNIX imposes no structure on user files either, they can be an arbitrary stream of bytes. This potentially useful feature was preserved by not doing any filtering of what the user entered as a message. Nonprintable ASCII characters were left unchanged when input and instead were converted to displayable form on output. By providing an option to turn off this output filtering (and carriage-return insertion for wrapping long text lines), we automatically created the capability of storing and sending graphic messages (or any other byte stream, for that matter).

The first tests of this technique were done using Tektronix codes and were quite successful. The currently supported code is NAPLPS (North American Presentation-Level-Protocol Syntax), which is an ANSI (American National Standards Institute) and international standard for representing graphs and images as special text and picture-drawing instructions. (See the four-part article by Jim Fleming and William Frezza, "NAPLPS: A New Standard for Text and Graphics," in the February through May 1983 issues of BYTE for more about NAPLPS.) This inherent graphics capability would have been impossible, or at least very difficult, had we limited ourselves by imposing any sort of structure as messages were input, a point in favor of not imposing limits on yourself until you have to.

User-Interface Implications

It is the user interface that can make or break the success and usability of a system (assuming that the basic requirements of a conferencing system are present). This has more to do with careful choice of command vocabulary, wording of prompts and help files, design of the command parser, and an intelligent choice of defaults than it does with the underlying

(continued)

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Conferencing-system users can discuss multiple subjects almost simultaneously.

storage architecture.

The particular file-system design can have more subtle effects. As we've already seen with the example of exchanging graphics via CoSy, the underlying architecture (in this case, the storage of message records in the topic file) can have a significant influence on how easy or difficult it is to implement desirable features for the user. There are other ramifications, too, in terms of how users cope with the volume of information available on a busy conferencing system.

For example, suppose you are a participant in two similar but distinct conferences on a given system, and you have something to say that really fits both conferences. You may also want to explicitly mail the same message to someone who is not participating in either conference but is a user of the system.

In COM, this can be done at a single stroke, because each message or "text" is stored only once, and all references to it (whether from a conference or an individual's mailbox) are via special pointers. Telecenter also stores each message as a single physical entity but uses the UNIX file system to maintain links or pointers to the appropriate places.

In the early version of Telecenter with which I am familiar, there is no single command to direct a message to several different conferences at once; the appropriate links have to be added later. CoSy does not provide such a linking mechanism at the message level. To place a message in more than one conference, it has to be physically copied from one to the other, increasing slightly the disk space used. There are, of course, commands to facilitate this copying.

It is possible for a whole topic to be shared between two or more conferences, with the messages entered by members of either conference available to all. In the systems described (CoSy, COM, and Telecenter) the messages entered into a conference (or conference topic) may be new thoughts, specific references, or answers to other messages.

In all three systems there is some indication when a given message is indeed a reference to or comment on another message. This contextual information is very useful—indeed, necessary—if an answering comment consists solely of "I agree" or "No." Telecenter doesn't go much beyond providing the number of the original message, but both CoSy and COM let you know, when you are reading a message, if there are any comments or responses to it. This is useful when reading an item that asks a question. It is helpful to know if anyone else has responded yet; if so, you may not need to bother answering.

COM and CoSy also provide ways for reading all the responses to a message before reading the next chronologically entered message. Other systems have similar mechanisms for handling messages and responses. In PARTICIPATE, for example, any message may have comments to it, forming a tree structure of comments, comments to comments, and so on. Any such message may become the root of a whole new conference with its own name.

CoSy also supports trees of comments to comments, but to start a new conference (or topic) at an arbitrary point, the relevant branches must be explicitly copied. In my opinion this keeps the system as a whole easier to manage and is perhaps less bewildering for users.

PicoSpan, developed by Marcus Watts, is another UNIX-based conferencing system. However, the structure of its messages and comments is perhaps more like a comb than a tree. In a PicoSpan conference, there can be sequential messages, called "items," with a number of "responses" to each. The user has the option of reading the responses before going on to the next message, as in COM or CoSy. However, in PicoSpan the responses are handled differently than the base-level sequential messages, and there is no additional level of branching. Hence, it has a comb structure, with the base-level messages, or items, forming the spine of the comb, and the responses forming the teeth. In some respects this can be viewed as a hypothetical CoSy conference in which any participant can add a new topic, and members are only allowed to comment on the first message in a topic.

SUMMARY

In this top-down comparison of conferencing systems I've illustrated some of the different trade-offs and compromises involved in designing systems that are intended for a broad audience. I've also shown how different decisions about data-storage methods (the storage architecture) can have later implications on what can or cannot be easily done in terms of adding new features or subsystems to existing programs.

I'm sure many of you have had to make a change in a program and thought, "Darn, if I'd done it that way instead, it would have been so easy." Or, if you're lucky or exceptionally farsighted, "Gee, I'm glad I did it this way, this new feature just slides right in."

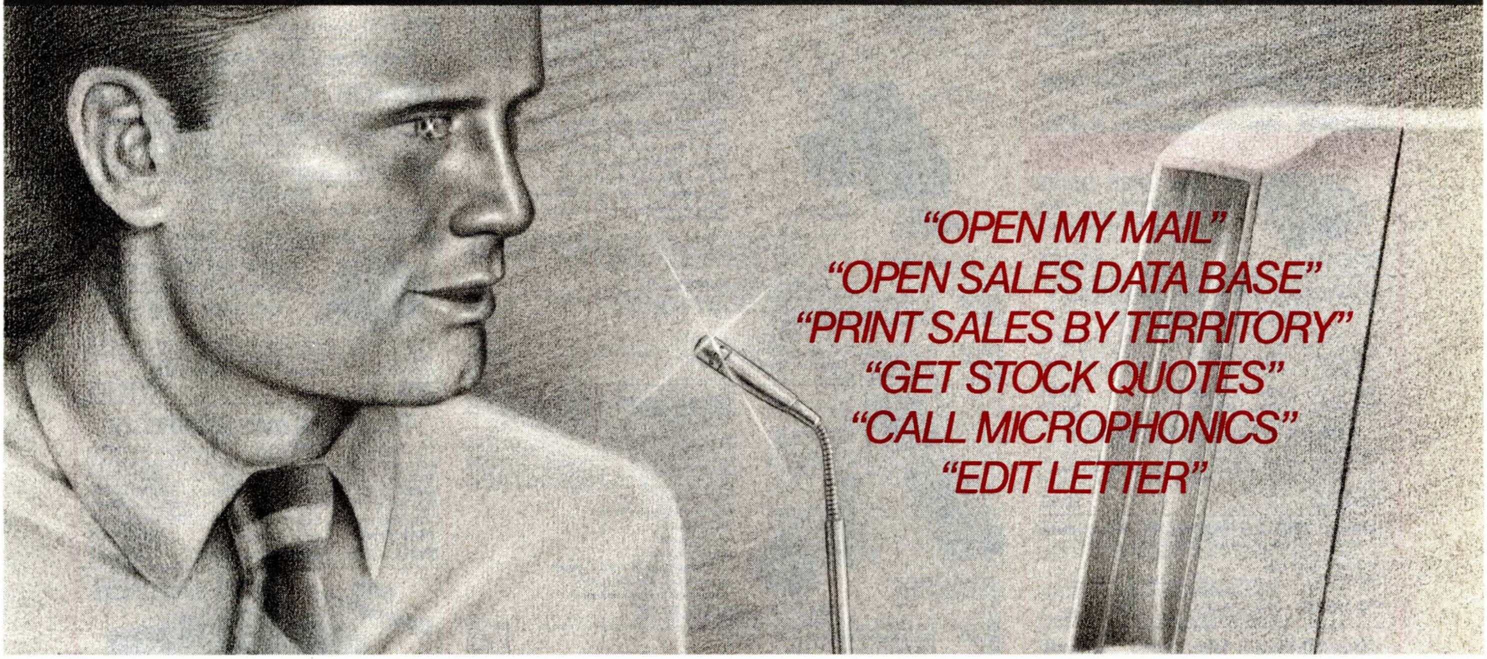
Any system design involves compromises. The decisions made generally depend more on the intended users and usage than any absolute scale of "good" or "efficient" design. It is always a good idea to keep the maximum number of options open for as long as possible. ■

REFERENCES

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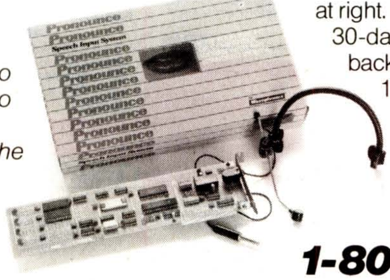
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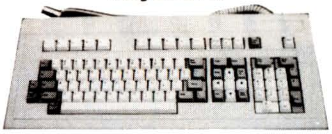
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SN74198N	24	1.35
SN74199N	14	1.35
SN74221N	16	.89
SN74251N	16	.89
SN74273N	20	1.95
SN74276N	20	2.49
SN74279N	16	.59
SN74283N	16	1.39
SN74284N	16	2.95
SN74285N	16	2.95
SN74365N	16	.59
SN74366N	16	.59
SN74367N	16	.59
SN74368N	16	.59
SN74390N	16	1.49
SN74393N	14	1.49

74LS

Part No.	Pins	Price
74LS00	14	.19
74LS01	14	.19
74LS02	14	.19
74LS03	14	.19
74LS04	14	.25
74LS05	14	.25
74LS06	14	.99
74LS07	14	.99
74LS08	14	.19
74LS09	14	.19
74LS10	14	.19
74LS11	14	.19
74LS12	14	.19
74LS14	14	.39
74LS15	14	.29
74LS20	14	.19
74LS21	14	.25
74LS26	14	.25
74LS27	14	.25
74LS28	14	.29
74LS30	14	.19
74LS32	14	.25
74LS33	14	.39
74LS37	14	.29
74LS38	14	.29
74LS42	16	.39
74LS47	16	.89
74LS48	16	.89
74LS51	14	.25
74LS54	14	.19
74LS73	14	.35
74LS74	14	.25
74LS75	16	.29
74LS76	16	.29
74LS85	16	.49
74LS86	14	.25
74LS90	14	.39
74LS92	14	.49
74LS93	14	.39
74LS96	16	.49
74LS107	16	.35
74LS109	16	.35
74LS112	16	.29
74LS122	14	.45
74LS123	16	.49
74LS125	14	.39
74LS126	14	.39
74LS132	14	.39
74LS133	16	.49
74LS136	14	.39
74LS138	16	.39
74LS139	16	.39
74LS145	16	.89
74LS147	16	.99
74LS148	16	.99
74LS151	16	.39
74LS153	16	.39
74LS154	24	1.49
74LS155	16	.49
74LS156	16	.49
74LS157	16	.35
74LS158	16	.35
74LS160	16	.69
74LS161	16	.39
74LS162	16	.69
74LS163	16	.49
74LS164	14	.49
74LS165	16	.79
74LS166	16	.89
74LS168	16	.99
74LS169	16	.99
74LS170	16	1.49
74LS173	16	.49
74LS174	16	.39
74LS175	16	.39
74LS181	24	1.49
74LS189	16	3.95
74LS190	16	.49
74LS191	16	.49
74LS192	16	.69
74LS193	16	.69
74LS194	16	.59
74LS195	16	.59
74LS196	14	.89
74LS197	14	.89
74LS221	16	.59
74LS240	20	.69
74LS241	20	.69
74LS242	14	1.09
74LS243	14	.69
74LS244	20	.69
74LS245	20	.79
74LS247	16	.99
74LS251	16	.49
74LS253	16	.49
74LS257	16	.39
74LS258	16	.49
74LS259	16	1.19
74LS260	14	.49
74LS261	16	1.49
74LS266	14	.49
74LS273	20	.79
74LS279	16	.39
74LS280	14	1.19
74LS283	16	.59
74LS289	16	3.95
74LS299	20	1.49
74LS322	20	2.95
74LS323	20	2.49
74LS347	16	.79
74LS353	16	1.19
74LS364	20	1.95
74LS365	16	.39
74LS366	16	.39
74LS367	16	.39
74LS368	16	.39
74LS373	20	.79
74LS374	20	.79
74LS375	16	.69
74LS377	20	.79
74LS386	14	.45
74LS390	16	1.09
74LS393	14	.79
74LS399	16	1.09
74LS490	16	1.49
74LS533	20	1.95
74LS534	20	1.95
74LS540	20	1.09
74LS541	20	1.09
74LS590	16	5.95
74LS624	14	1.95
74LS629	16	2.49
74LS640	20	.99
74LS641	20	1.29
74LS644	20	1.29
74LS645	20	.99
74LS670	16	.99
74LS688	20	1.95
81LS95	20	1.49
81LS96	20	1.49
81LS97	20	1.49
81LS98	20	1.49

74S/PROMS*

Part No.	Pins	Price
74S00	14	.29
74S02	14	.29
74S04	14	.35
74S05	14	.35
74S08	14	.35
74S09	14	.39
74S10	14	.29
74S11	14	.35
74S15	14	.35
74S20	14	.35
74S22	14	.35
74S30	14	.35
74S32	14	.35
74S37	14	.69
74S38	14	.69
74S64	14	.39
74S65	14	.39
74S74	14	.49
74S85	16	1.49
74S86	14	.35
74S112	16	.49
74S124	16	2.75
74S132	14	1.49
74S133	16	.45
74S135	16	.89
74S136	14	1.39
74S138	16	.79
74S139	16	.79
74S140	14	.55
74S151	16	.79
74S153	16	.79
74S157	16	.79
74S158	16	.89
74S160	16	4.95
74S169	16	3.95
74S174	16	.79
74S175	16	.79
74S188*	16	1.75
74S189	16	1.95
74S194	16	1.49
74S195	16	1.49
74S196	16	1.49
74S240	20	1.49
74S241	20	1.49
74S242	14	2.69
74S244	20	1.49
74S251	16	.79
74S253	16	.79
74S257	16	.79
74S258	16	.99
74S273	20	2.39
74S280	14	1.89
74S287*	16	1.69
74S288*	16	1.69
74S299	20	3.95
74S373	20	1.69
74S374	20	1.69
74S472*	20	3.49

74ALS

Part No.	Pins	Price
74ALS00	14	.35
74ALS02	14	.35
74ALS04	14	.39
74ALS05	14	.39
74ALS08	14	.35
74ALS10	14	.35
74ALS27	14	.39
74ALS30	14	.35
74ALS32	14	.39
74ALS74	14	.55
74ALS109	16	.55
74ALS112	16	.79
74ALS138	16	.89
74ALS174	16	.89
74ALS175	16	.89
74ALS240	20	1.79
74ALS244	20	1.79
74ALS245	20	2.49
74ALS373	20	1.95
74ALS374	20	1.95
74ALS573	20	1.95

74F

Part No.	Pins	Price
74F00	14	.59
74F02	14	.59
74F04	14	.65
74F08	14	.59
74F10	14	.59
74F32	14	.65
74F74	14	.69
74F86	14	.89
74F109	16	.89
74F138	16	1.19
74F139	16	1.29
74F157	16	1.29
74F158	16	1.29
74F193	16	4.95
74F240	20	2.49
74F241	20	2.49
74F244	20	2.49
74F251	16	1.49
74F253	16	1.79
74F257	16	1.39
74F373	20	2.95
74F374	20	2.95
74F379	16	2.19

CD—CMOS

Part No.	Pins	Price
CD4000	14	.19
CD4001	14	.19
CD4002	14	.25
CD4006	14	.69
CD4007	14	.25
CD4008	16	.89
CD4009	16	.39
CD4010	16	.39
CD4011	14	.19
CD4012	14	.25
CD4013	14	.35
CD4014	16	.69
CD4015	16	.25
CD4016	14	.29
CD4017	16	.49
CD4018	16	.69
CD4019	16	.35
CD4020	16	.59
CD4021	16	.69
CD4022	16	.69
CD4023	14	.25
CD4024	14	.49
CD4025	14	.25
CD4026	16	1.49
CD4027	16	.39
CD4028	16	.65
CD4029	16	.65
CD4030	14	.39
CD4034	24	1.39
CD4035	16	.85
CD4040	16	.65
CD4041	14	.75
CD4042	16	.59
CD4043	16	.69
CD4044	16	.69
CD4046	16	.69
CD4047	14	.89
CD4048	16	.59
CD4049	16	.29
CD4050	16	.29
CD4051	16	.65
CD4052	16	.65
CD4053	16	.65
CD4056	16	2.19
CD4059	24	3.49
CD4060	16	.89
CD4066	14	.29
CD4068	14	.29
CD4069	14	.25
CD4070	14	.29
CD4071	14	.25
CD4072	14	.25
CD4073	14	.25
CD4075	14	.25
CD4076	16	.89
CD4077	14	.29
CD4078	14	.29
CD4081	14	.25
CD4082	14	.25
CD4093	14	.39
CD4094	16	1.49
CD4098	16	1.49
CD4099	16	1.39
CD40103	16	2.95
CD4503	16	.49
CD4508	24	1.45
CD4510	16	.69
CD4511	16	.69
CD4512	16	.69
CD4514	24	.99
CD4515	24	1.39
CD4516	16	.79
CD4518	16	.79
CD4519	16	.39
CD4520	16	.79
CD4522	16	.79
CD4526	16	.79
CD4528	16	.79
CD4529	16	1.49
CD4531	16	.89
CD4538	16	.89
CD4541	14	.89
CD4543	16	.99
CD4553	16	4.95
CD4555	16	.89
CD4556	16	.89
CD4560	16	3.95
CD4566	16	1.95
CD4583	16	1.19
CD4584	14	.59
CD4585	16	.75
CD4723	16	1.19
CD4724	16	1.19
MC14411	24	9.95
MC14490P	16	4.49
MC14572	16	.89

SPECIAL!! SPECIAL!! SPECIAL!!



MOTOROLA

MC68701 — Microcomputer with EPROM

The MC68701 is an 8-bit single chip microcomputer unit (MCU) which significantly enhances the capabilities of the MC6800 family of parts. On-chip resources include 2048 bytes of EPROM, 128 bytes of RAM, Serial Communications Interface (SCI), parallel I/O, and a three function Programmable Timer.

MC68701. . . . . $24.95

CUSTOM COMMODORE CHIPS
for VIC-20, C-64 and C-128 Personal Computers

Part No.	Description	Price
*6510	CPU	$19.95
*6525	TPI	$20.95
*6526	CIA	$25.95
*6560	VIC-I	$29.95
*6567	VIC-II	$44.95
*6581	SID	$32.95
82S100PLA	PLA	$37.95

*SPECS. AVAILABLE @ $1.50 EA.

NOTE: 82S100 = U17 (C-64)

MICROPROCESSOR COMPONENTS

MICROPROCESSOR CHIPS

Part No.	Pins	Function	Price
D765AC	40	Floppy Disk Controller	4.95
CDP1802CE	40	CPU 2.5MHz	9.95
2661-3	28	Enhanced Prog. Comm. Interface	6.95
D3242	28	Addr. Multiplexer & Refresh Counter	6.95
Z80, Z80A, Z80B, SERIES			
Z80	40	CPU (MK3880N)(780C)2.5MHz	1.75
Z80-CTC	28	Counter Timer Circuit	1.79
Z80-DART	40	Dual Asynchronous Rec./Trans.	4.95
Z80-DMA	40	Direct Memory Access Circuit	4.95
Z80-P10	40	Parallel I/O Interface Controller	1.79
Z80-S10/0	40	Serial I/O (TxCB and RxCB Bonded)	4.95
Z80-S10/1	40	Serial I/O (Lacks DTRB)	4.95
Z80-S10/2	40	Serial I/O (Lacks SYNCB)	4.95
Z80-S10/9	40	Serial I/O	4.95
Z80A	40	CPU(MK3880N-4)(780C-1)4MHz	1.85
Z80A-CTC	28	Counter Timer Circuit	1.89
Z80A-DART	40	Dual Asynchronous Rec./Trans.	5.25
Z80A-DMA	40	Direct Memory Access Circuit	5.95
Z80A-P10	40	Parallel I/O Interface Controller	1.95
Z80A-S10/0	40	Serial I/O (TxCB and RxCB Bonded)	5.25
Z80A-S10/1	40	Serial I/O (Lacks DTRB)	5.25
Z80A-S10/2	40	Serial I/O (Lacks SYNCB)	5.25
Z80A-S10/9	40	Serial I/O	5.25
Z80B	40	CPU (MK3880N-6) 6MHz	3.95
Z80B-CTC	28	Counter Timer Circuit	4.95
Z80B-DART	40	Dual Asynchronous Rec./Trans.	6.95
Z80B-P10	40	Parallel I/O Interface Controller	4.95
Z80B-SIO/0	40	Ser.I/O (TxCB & RxCB Bond.) (MK3884-6)	12.95
Z80B-SIO/1	40	Serial I/O (Lacks DTRB)	12.85
Z80B-SIO/2	40	Serial I/O (Lacks SYNCB)	12.79
6500/6800/68000 SERIES			
6502	40	MPU with Clock (1MHz)	2.75
6502A	40	MPU with Clock (2MHz)	2.95
6502B	40	MPU with Clock (3MHz)	6.95
6520	40	Peripheral Inter. Adapter	2.95
6522	40	Versatile Inter. Adapter	4.95
6545	40	CRT Controller (CRTC)	4.95
6551	28	Async. Comm. Interface Adapt.	6.95
6800	40	MPU	1.95
6802	40	MPU with Clock and RAM	4.95
6809	40	CPU — 8-Bit (On-Chip Oscillator)	5.75
6809E	40	CPU — 8-Bit (External Clocking)	5.95
68B09E	40	CPU — 8-Bit (Ext. Clocking) 2MHz	7.25
6810	24	128x8 Static RAM	1.95
68B10	24	128x8 Static RAM (2MHz)	3.49
6821	40	Peripheral Inter.Adapt.(MC6820)	1.95
68B21	40	Peripheral Interface Adapter (2MHz)	3.95
6840	28	Programmable Timer	6.75
6843	40	Programmable Floppy Disk Controller	19.95
6845	40	CRT Controller (CRTC)	4.95
68B45	40	CRT Controller (CRTC) 2MHz	6.95
6850	24	Asynchronous Comm. Adapter	1.95
6852	24	Synchronous Serial Data Adapter	4.75
6860	24	0-600bps Digital MODEM	7.95
68000L8	64	MPU 16-Bit (8MHz)	9.95
68488P	40	General Purpose Int. Adapter	14.95
68661	28	Enhanced Prog. Comm. Interface (2661)	8.95
68701	40	Microcomputer with EPROM	24.95
8000/80000 SERIES			
8031	40	Control Oriented CPU w/RAM & I/O	6.95
8035	40	MPU — 8-Bit	1.95
8039	40	CPU—Sgl. Chip 8-Bit (128bts. RAM)	2.75
8060	40	CPU — 8-Bit NMOS	14.95
8073N	40	CPU w/Basic Micro Interpreter	29.95
8080A	40	CPU	3.95
8085A	40	CPU	2.75
8085A-2	40	CPU-8-Bit N-Channel(5MHz)	4.95
8086-2	40	CPU 16-bit 8MHz	8.95
8087	40	Arithmetic Processor (5MHz)	129.95
8087-2	40	Arithmetic Processor	139.95
8088	40	CPU 8/16-Bit	7.95
8116	18	Dual Baud Rate Generator	8.95
8155	40	HMOS RAM 1/0 Port-Timer	2.75
8156	40	RAM with I/O Port and Timer	2.75
8202	40	Dynamic RAM Controller	9.95
8203	40	64K Dynamic RAM Controller	29.95
8205	16	Hi Speed 1 out of 8 Binary Decoder	3.29
8212	24	8-Bit Input/Output (74S412)	1.95
8224	16	Clock Generator/Driver	2.25
8228	28	Sys. Cont./Bus Driver (74S428)	3.49
8237-5	40	High Perf. Prog. DMA Cont. (5MHz)	6.95
8238	28	System Controller (74S438)	4.29
8243	24	I/O Expander for 48 Series	2.49
8250A	40	Async. Comm. Element	6.95
8250B	40	ACE (IBM PC or XT Software Compatible)	5.95
8251	28	Prog. Comm. I/O (USART)	1.95
8251A	28	Prog. Comm. Interface (USART)	2.25
8253-5	24	Programmable Interval Timer	2.25
8254	24	Programmable Interval Timer	9.95
8255	40	Prog. Peripheral I/O (PPI)	1.95
8255A-5	40	Prog. Peripheral I/O (PPI) 5MHz	2.25
8257-5	40	Prog. DMA Controller	2.49
8259	28	Prog. Interrupt Control	2.25
8259-5	28	Prog. Interrupt Controller	2.49
8272	40	Sgle/Dble Density Floppy Disk Cont.	4.95
8274	40	Multi-Protocol Serial Cont. (7201)	14.95
8275	40	Prog. CRT Controller	14.95
8279	40	Prog. Keyboard/Display Interface	2.49
8279-5	40	Prog. Keyboard/Display Interface	2.95
8282	20	Octal Latch	3.95
8284	18	Clock Generator/Driver	2.95
8286	20	Octal Bus Transceiver	3.95
8287	20	Octal Bus. Transceiver (Inverted)	3.95
8288	20	Bus Controller	4.95
8289	20	Bus Arbiter	14.95
8741	40	8-Bit Univ. Peripheral Interface	8.95
8748	40	HMOS EPROM MPU	7.95
8749	40	MPU 8-Bit (EPROM Version of 8049)	9.95
8751	40	CPU w/4Kx8 EPROM & 128x8 RAM	29.95
8755	40	16K EPROM with I/O	14.95
80186	68	High Integration 16-Bit MPU	49.95
80188	68	High Integra. 16-Bit MPU (8-Bit Data Bus)	49.95
80287	40	Numeric Processor Ext.	229.95

DYNAMIC RAMS

Part No.	Pins	Function		Price
1103	18	1024x1	(300ns)	.69
4027	16	4096x1	(250ns)	.89
4116N-15	16	16,384x1	(150ns)	.45
4116N-20	16	16,384x1	(200ns)	.39
4128	16	131,072x1	(200ns)	4.95
4164N-150	16	65,536x1	(150ns)	.89
4164N-200	16	65,536x1	(200ns)	.79
TMS4416-12	18	16,384x4	(120ns)	4.95
MM5261	18	1024x1	(300ns)	.25
MM5262	22	2048x1	(365ns)	.25
MM5270	18	4096x1	(250ns)	1.95
MM5280	22	4096x1	(200ns) 2107	1.95
MM5298-3	16	8192x1	(200ns)	.19
8118	16	16,384x1	(120ns)(+5V Only Req.)	1.95
41256-150	16	262,144x1	(150ns)	3.29
41256-200	16	262,144x1	(200ns)	3.19
50464-15	18	65,536x4	(150ns)(41254)(41464)	7.95
STATIC RAMS				
TMM2016-12	24	2048x8	(120ns)	1.69
2101	22	256x4	(450ns) 8101	1.95
2102	16	1024x1	(350ns)	.89
2102-2L	16	1024x1	(250ns) L.P. (91L02)	1.49
2111	18	256x4	(450ns) 8111	2.49
2112	16	256x4	(450ns) MOS	2.49
2114N	18	1024x4	(450ns)	.99
2114N-L	18	1024x4	(450ns) L.P.	1.09
2114N-2	18	1024x4	(200ns)	1.05
2114N-2L	18	1024x4	(200ns) L.P.	1.49
21C14	18	1024x4	(200ns) (CMOS)	.49
2116N-25L	24	2048x8	(250ns) L.P. NMOS	3.49
2125A	16	1024x1	(45ns) High Speed	2.95
2147HN	18	4096x1	(70ns)	3.95
2148HN	18	1024x4	(70ns)	4.29
2149	18	1024x4	(45ns)	4.95
27LS00	16	256x1	(80ns) L.P.	2.95
TMS40L47-45	20	1024x4	(450ns)	.99
5101	22	256x4	(450ns) CMOS	3.95
MM5257	18	4096x1	(450ns) 4044	2.95
HM6116P-3	24	2048x8	(150ns) CMOS	1.79
HM6116LP-3	24	2048x8	(150ns) L.P. CMOS	1.85
HM6116P-4	24	2048x8	(200ns) CMOS	1.69
HM6116LP-4	24	2048x8	(200ns) L.P. CMOS	1.75
HM6264P-12	28	8192x8	(120ns) CMOS	4.69
HM6264LP-12	28	8192x8	(120ns) L.P. CMOS	4.79
HM6264P-15	28	8192x8	(150ns) CMOS	4.49
HM6264LP-15	28	8192x8	(150ns) L.P. CMOS	4.59
6514	18	1024x4	(350ns)CMOS(UPD444C)	4.49
74S189	16	16x4	(35ns)	1.95
74S289	16	16x4	(35ns) 3101	2.95
PROMS/EPROMS				
1702A	24	256x8	(1μs)	3.95
TMS2516	24	2048x8	(450ns)	3.49
TMS2532	24	4096x8	(450ns) NMC2532	3.95
TMS2564	28	8192x8	(450ns)	8.95
2708	24	1024x8	(450ns)	3.95
TMS2716	24	2048x8	(450ns) 3 voltage	6.49
2716	24	2048x8	(450ns)	2.49
27C16	24	2048x8	CMOS	9.95
2716-1	24	2048x8	(350ns)	2.95
2732	24	4096x8	(450ns)	2.49
2732A-20	24	4096x8	(200ns) 21V	3.95
2732A-25	24	4096x8	(250ns) 21V	2.95
2732A-45	24	4096x8	(450ns) 21V	2.75
27C32	24	4096x8	CMOS	10.95
2758	24	1024x8	(450ns) Single +5V	3.95
2764-20	28	8192x8	(200ns) 21V	3.95
2764-25	28	8192x8	(250ns) 21V	2.95
2764A-25	28	8192x8	(250ns) 12.5V	2.95
2764-45	28	8192x8	(450ns) 21V	2.19
27C64	28	8192x8	CMOS 21V	6.95
27128-25	28	16,384x8	(250ns) 128K 21V	2.95
27128A-25	28	16,384x8	(250ns) 128K 12.5V	4.95
27256-25	28	32,768x8	(250ns) 256K (14V)	7.95
27C256-25	28	32,768x8	(250ns) 256K (CMOS)	13.95
68764	24	8192x8	(450ns) 25V	15.95
68766	24	8192x8	(350ns) 25V	16.95
74S188	16	32x8	PROM O.C. (6330-1)	1.75
74S287	16	256x4	PROM T.S. (6301-1)	1.69
74S288	16	32x8	PROM T.S. (6331-1)	1.69
74S387	16	256x4	PROM O.C. (6300-1)	1.69
74S471	20	256x8	PROM T.S. (6309-1)	4.95
74S472	20	512x8	PROM T.S. (6349-1)	3.49
74S473	20	512x8	PROM O.C. (6348)	2.95
74S474	24	512x8	PROM T.S. (DM87S296N)	3.49
74S475	24	512x8	PROM O.C. (6340)	3.49
74S476	18	1024x4	PROM T.S.	4.95
74S570	16	512x4	PROM O.C. (6305)	2.95
74S571	16	512x4	PROM T.S. (6306)	2.95
74S572	18	1024x4	PROM O.C. (6352)	3.49
74S573	18	1024x4	PROM T.S. (82S137)	2.95
82S23	16	32x8	PROM O.C. (27S18)	2.49
82S115	24	512x8	PROM T.S. (27S15)	9.95
82S123	16	32x8	PROM T.S. (27S19)	2.95
82S126	16	256x4	PROM O.C. (27S20)	2.95
82S129	16	256x4	PROM T.S. (27S21)	2.95
82S130	16	512x4	PROM O.C. (27S12)	3.95
82S185	18	2048x4	PROM T.S. (TBP24S81)	9.95
82S191	24	2048x8	(80ns)	14.95
DM87S181N	24	1024x8	PROM T.S. (82S181)	9.95

DATA ACQUISITION

Part No.	Pins	Function	Price
ADC0800	18	8-Bit A/D Converter (±1 LSB)	14.49
ADC0801	20	8-Bit A/D Converter (1/4LSB)	14.95
ADC0803	20	8-Bit A/D Converter (±1/2LSB)	5.95
ADC0804	20	8-Bit A/D Converter (1LSB)	3.49
ADC0808	28	8-Bit A/D Conv. w/8-Channel Analog	8.95
ADC0809	28	8-Bit A/D Converter (8-Ch. Multi.)	3.95
ADC0816	40	8-Bit A/D Conv. w/16-Channel Analog	14.95
ADC0817	40	8-Bit A/D Converter (16-Ch. Multi.)	8.95
ADC0832	8	8-Bit Ser. I/O A/D Conv. (2,4, or 8-Ch. Mult.)	4.95
DAC0800	16	8-Bit D/A Converter (±1 LSB)	3.95
DAC0806	16	8-Bit D/A Converter (0.78% Lin.)	1.95
DAC0807	16	8-Bit D/A Converter (MC1408-7)	1.49
DAC0808	16	8-Bit D/A Converter (MC1408-8)	1.95
DAC0830	20	8-Bit Up D/A Conv. (.05% Lin.)	5.95
DAC0831	20	8-Bit Up D/A Conv. (.10% Lin.)	4.49
DAC1000	24	10-Bit D/A Conv. Micro. Comp. (0.05%)	4.95
DAC1008	20	8-Bit D/A Conv. Micro. Comp. (0.20%)	7.95
DAC1022	16	10-Bit D/A Conv. (0.20% lin.)	5.95
DAC1222	18	12-Bit D/A Conv. (0.20% Lin.)	6.95
DAC1230	20	12-Bit Up D/A Conv. (.012% Lin.)	14.95
DAC1231	20	12-Bit Up D/A Conv. (.024% Lin.)	13.95
AY-3-1015D	40	25K Baud UART	4.95
AY-5-1013A	40	30K Baud UART (TR1602)	3.95



Low Profile (Tin) Sockets

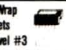
Part No.	1-9	10-99	100-up
8 pin LP	.13	.12	.11
14 pin LP	.15	.13	.11
16 pin LP	.17	.15	.13
18 pin LP	.25	.23	.21
20 pin LP	.28	.26	.23
22 pin LP	.30	.28	.26
24 pin LP	.31	.30	.29
28 pin LP	.39	.37	.35
40 pin LP	.49	.46	.43



Soldertail (Gold) Standard

Part No.	1-9	10-99	100-up
8 pin SG	.39	.35	.29
14 pin SG	.49	.45	.39
16 pin SG	.55	.49	.45
18 pin SG	.65	.59	.51
20 pin SG	.75	.65	.59
22 pin SG	.79	.69	.65
24 pin SG	.79	.69	.65
28 pin SG	.95	.85	.75
36 pin SG	1.25	1.15	.99
40 pin SG	1.39	1.25	1.15

Wire Wrap Sockets (Gold) Level #3



Part No.	1-9	10-99	100-up
8 pin WW	.55	.49	.45
10 pin WW	.65	.59	.55
14 pin WW	.69	.65	.59
16 pin WW	.75	.69	.65
18 pin WW	.85	.79	.75
20 pin WW	.95	.89	.85
22 pin WW	.99	.95	.89
24 pin WW	1.19	1.09	.99
28 pin WW	1.39	1.29	1.19
36 pin WW	1.49	1.39	1.29
40 pin WW	1.79	1.69	1.59



Header Plugs (Gold)

Part No.	1-9	10-99	100-up
14 pin HP	.55	.49	.45
16 pin HP	.59	.55	.49
24 pin HP	.99	.89	.79

Header Covers

Part No.	1-9	10-99	100-up
14 pin HC	.15	.13	.12
16 pin HC	.19	.17	.15
24 pin HC	.29	.27	.25

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FE0203D	40	3½ Digit LCD Display for 7106 & 7116	12.95
7045IPI	28	CMOS Precision Timer	11.95
7045EV/Kit	28	Stopwatch Chip, XTL (Evaluation Kit)	16.95
7106CPL	40	3½ Digit A/D (LCD Drive)	8.95
7106EV/Kit	40	IC, Circuit Board, Display (Evaluation Kit)	46.95
7107CPL	40	3½ Digit A/D (LED Drive)	8.95
7107EV/Kit	40	IC, Circuit Board, Display (Evaluation Kit)	46.95
7116CPL	40	3½ Digit A/D LCD Dis. HLD	8.95
7201IUS		Low Battery Volt. Indicator	2.29
7205IPG	24	CMOS LED Stopwatch/Timer	14.95
7205EV/Kit	24	Stopwatch Chip, XTL (Evaluation Kit)	16.95
7206CJPE	16	Tone Generator	4.95
7206CEV/Kit	16	Tone Generator Chip, XTL (Evaluation Kit)	7.95
7207AIPD	14	Oscillator Controller	5.95
7207AEV/Kit	14	Freq. Counter Chip, XTL (Evaluation Kit)	8.49
7211IPL	40	4 Digit LCD Display Decoder/Driver (TTL compatible)	7.95
7211MIPL	40	4 Digit LCD Display Decoder/Driver (Microproc. compat.)	8.49
7215IPG	24	4 Func. CMOS Stopwatch CKT	16.95
7215EV/Kit	24	4 Func. Stopwatch Chip, XTL (Evaluation Kit)	19.49
7216AIJI	28	8 Digit Univ. Counter C.A.	31.49
7216DIPI	28	8 Digit Freq. Counter C.C.	21.49
7217IJI	28	4 Digit LED Up/Down Counter C.A.	10.95
7217AIPI	28	4 Digit LED Up/Down Counter C.C.	8.95
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7226AEV/Kit	40	5 Function Counter Chip, XTL (Evaluation Kit)	99.95

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74HC HIGH SPEED CMOS

Part No.	Pins	Price
74HC00	14	.35
74HC02	14	.39
74HC03	14	.39
74HC04	14	.39
74HCU04	14	.39
74HC08	14	.39
74HC10	14	.39
74HC11	14	.39
74HC14	14	.59
74HC20	14	.39
74HC27	14	.39
74HC30	14	.39
74HC32	14	.45
74HC42	16	.75
74HC51	14	.39
74HC58	14	.39
74HC73	14	.45
74HC74	14	.45
74HC75	16	.69
74HC76	16	.69
74HC85	16	1.19
74HC86	14	.59
74HC107	14	.49
74HC109	16	.49
74HC112	16	.49
74HC123	16	1.19
74HC125	14	.99
74HC132	14	.79
74HC137	16	1.19
74HC138	16	.79
74HC139	16	.79
74HC147	16	.99
74HC151	16	.79
74HC153	16	.79
74HC154	24	1.95
74HC157	16	.79
74HC158	16	.79
74HC160	16	.89
74HC161	16	.89
74HC162	16	.89
74HC163	16	.89
74HC164	14	.99
74HC165	16	1.49
74HC166	16	1.95
74HC173	16	.89
74HC174	16	.89
74HC175	16	.89
74HC190	16	1.19
74HC191	16	1.19
74HC192	16	.99
74HC193	16	.99
74HC194	16	.89
74HC195	16	.89
74HC221	16	1.95
74HC237	16	1.19
74HC240	20	1.39
74HC241	20	1.39
74HC242	14	1.39
74HC243	14	1.39
74HC244	20	1.49
74HC245	20	1.59
74HC251	16	.79
74HC253	16	.79
74HC257	16	.79
74HC259	16	1.19
74HC266	14	.69
74HC273	20	1.79
74HC280	14	2.95
74HC299	20	3.19
74HC366	16	1.49
74HC367	16	1.49
74HC373	20	1.49
74HC374	20	1.49
74HC390	16	1.19
74HC393	14	1.19
74HC533	20	1.95
74HC534	20	1.95
74HC595	16	1.95
74HC688	20	1.95
74HC4024	14	1.19
74HC4040	16	1.19
74HC4049	16	.79
74HC4050	16	.79
74HC4060	16	1.19
74HC4075	14	.49
74HC4078	14	.49
74HC4511	16	1.95
74HC4514	24	2.95
74HC4538	16	1.95
74HC4543	16	2.95

74HCU04 is unbuffered.

74C—C/MOS

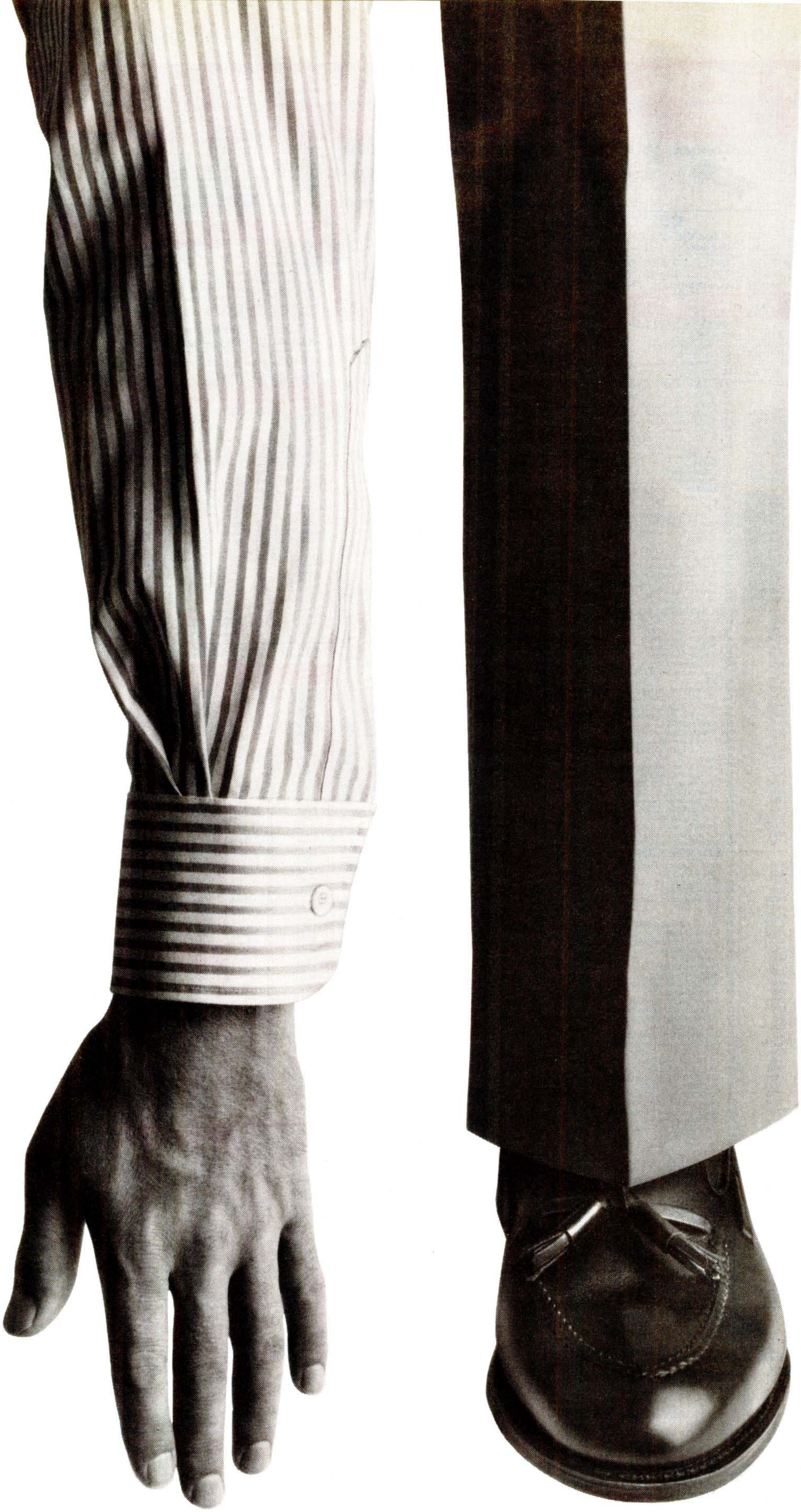
Part No.	Pins	Price
74C00	14	.29
74C02	14	.29
74C04	14	.25
74C08	14	.35
74C10	14	.29
74C14	14	.49
74C20	14	.29
74C30	14	.29
74C32	14	.35
74C42	16	.89
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74C160	16	.89
74C161	16	.89
74C162	16	.89
74C163	16	.89
74C164	14	.99
74C165	16	.99
74C173	16	.89
74C174	16	.89
74C175	16	.89
74C192	16	.99
74C193	16	.99
74C195	16	.99
74C221	16	1.19
74C240	20	1.59
74C244	20	1.59
74C373	20	1.95
74C374	20	1.95
74C901	14	.49
74C902	14	.49
74C903	14	.49
74C906	14	.49
74C907	14	.59
74C911	28	7.95
74C912	28	7.95
74C915	18	1.19
74C917	28	7.95
74C920	22	9.95
74C921	18	9.95
74C922	18	3.95
74C923	20	3.95
74C925	16	4.95
74C926	18	4.95
74C930	18	9.95
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80C97	16	.69

LINEAR

Part No.	Pins	Price
DS0026CN	8	1.69
TL064CN	14	1.95
TL071CP	8	.59
TL072CP	8	.79
TL074CN	14	.79
TL081CP	8	.49
TL082CP	8	.69
TL084CN	14	1.09
LM109K		4.95
LM301CN	8	.35
LM302H		.69
LM304H		.99
LM305H		.99
LM307CN	8	.45
LM308CN	8	.59
LM309K		1.25
LM310CN	8	1.29
LM311CN	8	.45
LM312H		1.49
LM317T		.99
LM317K		2.95
LM318CN	8	1.19
LM319N	14	1.19
LM320K-5		1.35
LM320K-12		1.35
LM320K-15		1.35
LM320K-24		1.35
LM320T-5		.59
LM320T-12		.59
LM320T-15		.59
LM320T-24		.59
LM322N	14	1.49
LM323K		4.49
LM324N	14	.39
LM329DZ		.55
LM331M	8	3.49
LM334Z		1.19
LM335Z		1.29
LM336Z		1.09
LM337MP		1.15
LM337T		1.49
LM338K		3.95
LM339N	14	.49
LM340K-5		1.35
LM340K-12		1.35
LM340K-15		1.35
LM340K-24		1.35
LM340T-5		.49
LM340T-12		.49
LM340T-15		.49
LM340T-24		.49
LF347N	14	.99
LM348N	14	.69
LM350K		3.95
LF351N	8	.49
LF353N	8	.59
LF355N	8	.89
LF356N	8	.89
LM358N	8	.49
LM359N	14	1.59
LM370N	14	4.95
LM373N	14	4.95
LM377N	14	1.95
LM380CN	8	1.09
LM380N	14	.89
LM381N	14	1.29
LM382N	14	1.29
LM384N	14	1.69
LM386N-3	8	.89
LM387N	8	.99
LM389N	18	.99
LM391N-80	16	1.29
LM392N	8	.59
LM393N	8	.45
LF398N	8	2.39
LM399H		3.95
LF412CN	8	1.49
TL494CN	16	1.95
TL496CP	8	1.59
TL497ACN	14	2.19
NE531V	8	1.79
NE540H (C540H)		2.95
NE544N	14	1.49
NE550A	14	.69
NE555V	8	.29
XR-L555	8	.69
LM556N	14	.59
NE558N	16	1.19
NE564N	16	1.95
LM565N	14	.99
LM566CN	8	1.39
LM567V	8	.89
NE570N	16	2.49
NE571N	16	1.95
NE592N	14	.89
LM703CN	8	1.19
LM710N	14	.69
LM711N	14	.69
LM723N	14	.45
LM733N	14	.69
LM739N	14	2.95
LM741CN	8	.29
LM747N	14	.59
LM748N	8	.59
UA760HC		1.29
LM1456V	8	1.95
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LM1489N	14	.69
LM1496N	14	.99
LM1605CK		9.95
LM1871N	18	1.95
LM1872N	18	2.49
LM1877N-9	14	2.49
LM1889N	18	1.59
LM1896N	14	1.59
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XR2206	16	3.95
XR2207	14	2.49
XR2208	16	1.79
XR2211	14	2.95
LM2877P		1.95
LM2878P		2.19
LM2901N	14	.59
LM2902N	14	.59
LM2907N	14	1.95
LM2917N	8	1.55
LM2935T		1.49
LM3900N	14	.59
LM3905CN	8	1.19
LM3909N	8	.89
LM3911N	8	1.19
LM3914N	18	1.95
LM3915N	18	1.95
LM3916N	18	1.95
RC4136N	14	.89
RC4151NB	8	.99
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LM4250CN	8	1.19
NE5532	8	.99
NE5534	8	.89
78L05A		.35
78L12A		.35
79L05A		.59
79M05AH		.69
ICL8038	14	3.95
LM13080N	8	1.19
LM13600N	16	1.19
75477	8	1.19
76002	14	1.25
76477	28	3.95

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Inquiry 191



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Inquiry 157

COMMON GROUND

BY CHRIS HANCOCK

The user-friendliness of this microcomputer-based conferencing system derives from its easy-to-visualize functions

IN THE COURSE of putting together a computer-based conference for science teachers, my colleagues and I wound up writing a complete conferencing system that runs on a microcomputer. It's called Common Ground, and we think it's the best in its class. In this article I'll talk about the program and some of the thinking that went into its design, and I'll present some of the program's internal structures. I'll also discuss some issues to consider in running your own conference using Common Ground.

The Educational Technology Center is an organization funded by the National Institute of Education and based at the Harvard Graduate School of Education. Its mission is to study how computers and other new technologies might help improve the teaching of math, science, and computing. One problem we've been looking at is the isolation of science teachers: Many science teachers, especially in rural areas, have very limited opportunities to share ideas with colleagues or to find out what's new and interesting in their scientific fields. Computer conferencing seems to be one promising way to address the problem. We've been putting together an experimental computer-based conference for science teachers in order to see the ways it might help.

We needed our conferencing software to satisfy several requirements. First, it had to be easy to understand and use; this was our single most important criterion. At the same time, it needed to be a real conferencing system with enrolled participants, full capabilities for private messages, flexible organization of public discussions, and effective ways of searching through messages to find what you're looking for. Finally, we wanted a system that would run on a microcomputer.

School districts, like many other organizations, have modest budgets, and for most of them a large computer is out of reach. Of course, there are limitations to using a microcomputer. For the time being, at least, most micros can support only one user at a time. This imposes a pretty hard limit on the total number of participants, but the limit is not as low as one might think, provided people's schedules are varied enough. We have seen a conference with as many as 100 regular participants run comfortably on a micro. Given that one of our goals is to develop a strong conference community, more than 100 people would probably be undesirable anyway. The one-user-at-a-time limit also means that occasionally you do get a busy signal when you call, and you have to try again later. This wouldn't do for businesses where messages need to get through quickly and without fail, but for our application that isn't so crucial.

AN EASY SYSTEM TO USE

We couldn't find the system we wanted, so I wrote it. We feel that its simplicity and ease of use are a design triumph. The single most important reason for this is the spatial metaphor around which the system is structured. We picture the Common Ground system as a building with rooms in it. Every enrolled participant has a private office that no one else can get into. Private mail sent to a par-

(continued)

Chris Hancock is a project associate at Harvard's Educational Technology Center (Gutman 337, Harvard Graduate School of Education, 6 Appian Way, Cambridge, MA 02138).

ticipant is delivered to that person's office. The building also has other rooms, called forums, that anyone can visit. Each forum is devoted to a particular discussion topic.

The power of the spatial metaphor is that it makes it easy to understand the state of the program ("where" you are in it) at any moment. Most interactive programs can change their states in a couple of ways: The data that is active or loaded may change (for example, you might load a new text file into a word-processor buffer) or the current mode may change (for example, in a database program you might go from record-definition mode to data-entry mode). In the Common Ground system, the idea of moving from room to room stands for a change of active data. When you are in your office, you have access to your personal mail; if you move to a public forum, you have access to the public mail there. As for modes, I have consciously worked to keep the number to a minimum. In fact, for the ordinary user there are just three modes. The main mode has just 10 commands. Then there's message-entry mode, where you type in your messages. The third mode is the text editor, which can be avoided by novices. (There are also special modes for the operator and other privileged users.) The main-mode commands are as follows:

scan: lists the messages in the current room.
read: reads messages in the current room. The scan and read commands both accept qualifiers that select messages in the room, based on date, author, topic, and whether you've read them before.
send: sends a message to any room or combination of rooms. The send command features a line editor for those who want to edit their messages before sending them.
scout: lists all forums on the system and the number of new (for you) messages in each one.
visit: lets you move from room to room.
home: takes you back to your own office.
whois: provides information about a participant or a forum.
set: lets you change your password as well as specify the width and height of your screen.
help: provides full on-line documentation.
bye: ends the session.

The short sample session shown in figure 1 gives the flavor of the system. As you can see, private and public mail is read and sent in pretty much the same way, using the read, scan, and send commands. Their effect simply depends on what room you're in and what room(s) you send messages to. This is a good example of the design principle known as orthogonality: One set of features operates independently from another set, with every possible combination having a meaning.

Orthogonality is prized by software people because it generally lets you express a lot in terms of just a few basic concepts. Sometimes, though, an orthogonal structure forces you to abandon your commonsense understanding of the application in favor of a more abstract one. This trade-off came up in the issue of groups and forums. Besides participants and forums, there is one other kind of entity to which you can address a message: a group. Groups do not correspond to rooms in the system. Instead, each group has a membership list, and any message sent to that group is distributed to the offices of all members of the group. Membership in groups is controlled; you have to ask to be enrolled in them. Groups are intended for topics that are confidential or urgent.

So groups and forums differ in two ways: Groups have restricted access, while forums have open access; and group messages are delivered to their members, while forum messages go to a room of their own. Thinking orthogonally, it's possible to imagine two other kinds of entities: forums with limited access, so that not everyone can visit them; and groups with free access, which participants can enroll in at will (perhaps using commands like subscribe and cancel, to invoke the home-delivery feature).

This time, we decided the orthogonality wasn't worth it. For one thing, it makes the solution more complicated than the problem. For almost any conceivable purpose, one of the existing options (forum or group) will do just fine. Moreover, a lot of attention devoted to access and privacy schemes would be out of place in a system intended to promote a feeling of community. The other important consideration was simplicity. Forums and groups are easy to understand: The words "forum" and "group" resonate well with the way they actually work on the system. Abstracting out the two dimensions they differ on would lose us that valuable intuitive base, unless we devoted a lot of effort and emphasis to a more extended metaphor (perhaps involving keys or secret passwords to forum rooms, which begins to seem more like an adventure game!).

Design Issues

The most important work in producing a piece of software like Common Ground is not implementing it but specifying it—designing the way it will appear to users. Furthermore, in order to decide how the program should behave, you need, in effect, to design all the activities that will take place around the program. It is vital to recognize that the software system functions as a part of a larger system of human and technical interactions. As the principle of top-down design implies, the first task is to design that larger system and then to proceed down to the computer program itself. Design decisions at the top level will have implications for the design of the actual program.

In principle, this is true for any program. It is crucial in the case of a computer conferencing program for two reasons. First, computer conferencing consists of more than just the running of a computer program. Second, because computer conferencing is in its infancy, there are plenty of open questions concerning how a con-

LOCAL POWER IN A REMOTE LINK

BY CHUCK MCMANIS

Conferencing systems can let micros handle much of the processing load

BY FAR THE MOST common remote systems are those that handle electronic conferencing. Despite their diversity, most of these systems share one unpleasant characteristic: They are too slow. However, there is a solution. The designers of conferencing systems can incorporate facilities into conferencing software for allowing microcomputers to handle much of the conferencing load.

This article describes a two-part software solution to the traditional I/O (input/output) bottleneck when you connect to a remote computer system. The first is a method of encoding the information you transmit to decrease the average number of bits per character. The second transfers from the conferencing system to your computer the task of providing the user interface.

As a user of the conferencing system, you will experience a dramatic increase in speed. With a faster connection, you can get more done in the same amount of time or reduce the amount of connect time. And, because you can personalize the commands, you will also find it easier to use the system.

System administrators will also experience a dramatic increase in speed. As the serial lines become intelligent I/O channels, they demand less of the CPU (central processing unit). The system could therefore support more serial lines, permitting more subscribers to have access to the system, or you might be able to use a less powerful, less expensive computer.

The relatively slow speed of remote systems owes mainly to two factors. The first is the rate at which the data can transfer to your system over a voice-grade phone line. The second concerns the sheer size of the data. Even in modest microcomputer bulletin-board systems (BBSs), the data can total several megabytes a month. Larger systems handle several megabytes a day. Handling all of this data does not require sophisticated numerical abilities, but it can quickly overwhelm the I/O bandwidth of any system.

There are two ways to mitigate the I/O bottleneck. One is to improve the communications hardware between the conferencing system and the remote site. Manufacturers are making remarkable improvements in this area. There are now full-duplex, 2400-bps (bits per second), asynchronous modems at prices that were attractive for 1200-bps modems five years ago. The other method is to maximize use of the existing bandwidth by adding an I/O processor at the remote site. This might seem more expensive than upgrading your communications hardware until you consider that, already at the remote site, there is probably an I/O processor, your computer, that is acting like a very expensive piece of wire between your terminal and the modem.

You can use your computer as an I/O processor in one of two ways. First, you could implement some form of data compression on the data stream between your computer and the host system. A somewhat more involved solution is to have your computer provide some of the facilities that the conferencing system traditionally provides.

(continued)

Chuck McManis is an engineer at Intel. He has been programming professionally for 10 years and spends his spare time writing system software for a Cromemco S-100 system running CP/M with ZCPR3. He can be reached at 1141 Vasquez Ave., Sunnyvale, CA 94086.

Data-compression techniques maximize the amount of meaningful information in a given number of bits by applying some statistical analysis on the original data. Obviously the frequency of occurrence of various ASCII (American Standard Code for Information Interchange) codes in text-only data streams will be greater than others; several letters appear often and most special symbols appear infrequently. One way to take advantage of this information is to apply a data-compression algorithm that reduces the number of bits used for frequently used characters. Huffman encoding, for example, can provide compressions on the order of 25 percent when used with a fixed encoding/decoding tree for textual data. With 25 percent compression a modem that transmits at 1200 bps will have an effective data-transfer rate of 1500 bps.

Data compression is effective for reducing the number of bits that you transmit to the host system, but you can program your computer to further reduce the amount of data you need to send. Careful analysis of the facilities that conferencing systems provide indicates that you can implement many of these facilities equally well with your computer.

WHAT IS THE CONFERENCING SYSTEM DOING?

A conferencing system has two parts, the user interface and low-level code to open data files and display them on a terminal. The low-level code is machine-dependent, but the user interface is entirely the creation of the programmer who designed it. Generally, there are three principal capabilities: editing, command interpretation, and user-profile maintenance.

A computer system that accepts spontaneous user input must have built-in editing facilities. The degree of editing complexity can range from a single cancel command that erases previous input and allows you to start again, to a full set of line- and character-manipulation commands. During command entry, you are usually limited to using the backspace or delete key to erase the previous character. Occasionally, you also have the option to delete the entire line. This type of editing is simple to implement in the terminal driver of the conferencing system. However, it requires some CPU intervention to determine if a character is in the input buffer when the delete key is pressed, to erase the character from your screen, or to indicate in some other way that the character has been discarded from the input stream.

Complex editing places more demand on the CPU. For example, when editing messages (limited-distribution files that are the basic unit of an electronic mail system), you must frequently change characters or words on a line other than the one on which you are currently working. Typically, the conferencing system will have available a section of code, either an integral part of the system or a separate program, for editing large amounts of input. The code may use some features of your terminal or none at all. Typically you will use this editor often, but it will probably differ from the other editors you regularly use.

Both line editors and screen editors help you to manipulate text before you send it to the world or save it in a file. Line editors were initially developed to be used over low-speed data lines, such as a modem connection, and with hard-copy terminals, such as the Teletype model 33. Line editors minimize the amount of information that you must transmit through the modem, but at the expense of both user-friendliness and cohesiveness of the displayed output. They perform equally well on dumb or smart terminals and are therefore somewhat "universal" in nature. Screen editors, on the other hand, were developed for use on high-speed data lines and are much more user-friendly. They can keep the message display up to date with continuous screen updates. However, continual updates reduce the effective data rate of your modem since character insertions and deletions can cause the updated contents of the message buffer to rewrite large portions of the screen. A screen editor also needs to know more about your terminal functions than does a line editor. For example, it needs to know how your terminal addresses the cursor and how it clears a line. Naturally, managers cannot possibly know all of the various terminals that will access the system, nor can they write software to support all possible terminals and still leave room in memory for other things. As a result, screen editors are much less common on conferencing systems. Some editors, such as Digital Equipment Corporation's EDT, attempt to fill the needs of all users by changing from a line editor to a screen editor on command.

However, the editing functions of the conferencing system are some of the easiest to give to your computer.

YOUR COMPUTER CAN HELP

If the conferencing program could command your computer to get an edited line of text from your keyboard, you would free up the time and memory that the conferencing system would normally use to provide the editing functions. Admittedly, this is a rather small portion of the overhead associated with command input. However, when applied to several users, the time savings was significant enough for IBM to provide this capability in its 3270 series terminals.

The next logical step would be a command from the conferencing system asking your computer to return an entire block of already-edited text. As opposed to the rather crude "block" mode of some terminals, your computer could invoke your favorite editor for entering a message or article and then transmit the edited text to the conferencing system only after you were satisfied with its appearance.

There are several benefits to local editing. First, the response time will be independent of both your modem speed and the number of users accessing the conferencing system. Second, it eliminates the performance

(continued)

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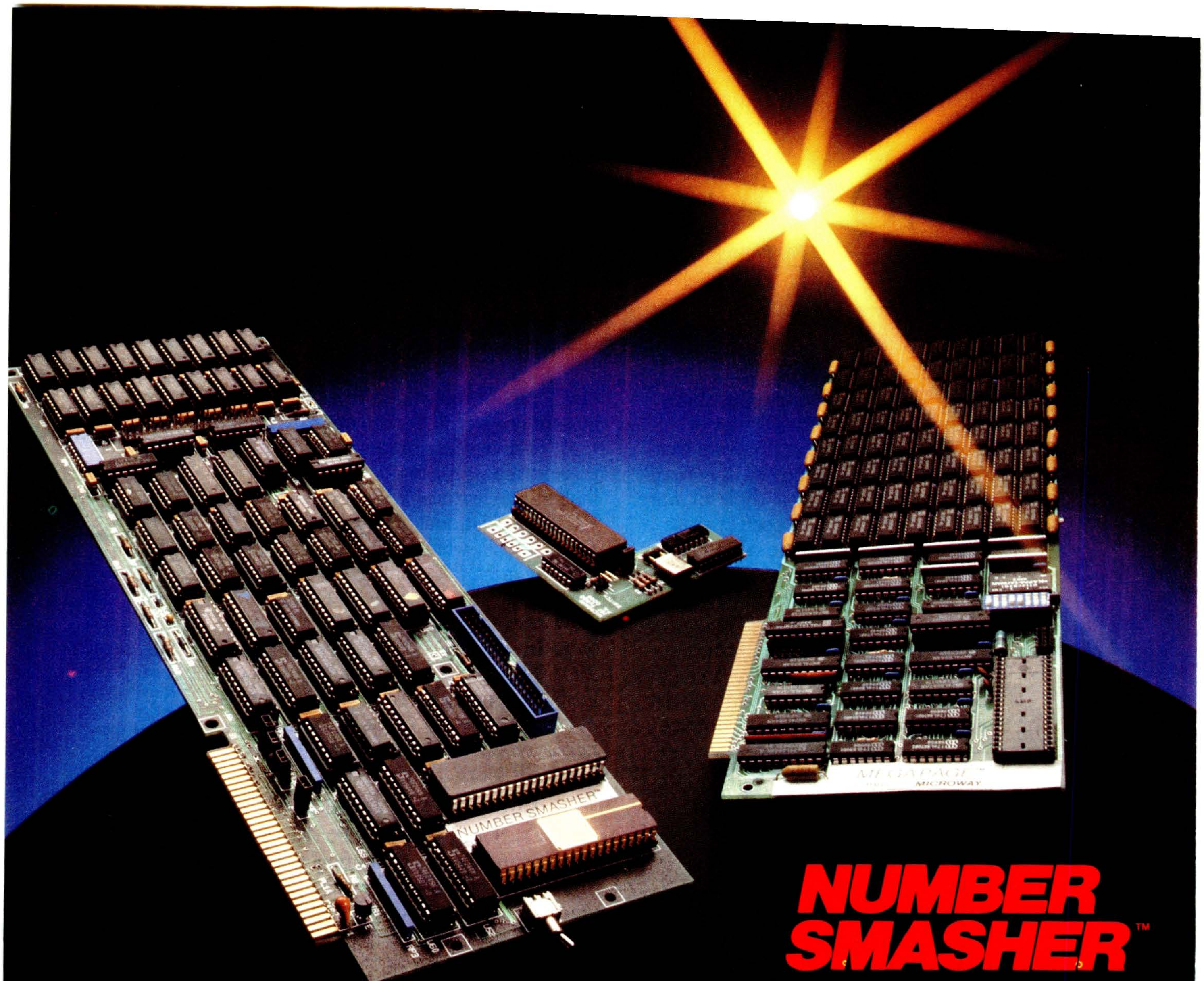
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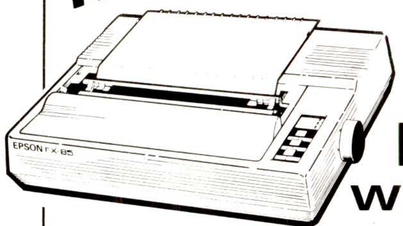
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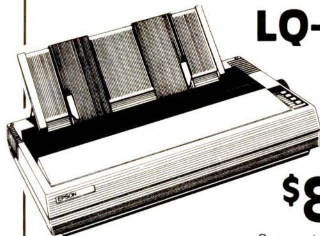


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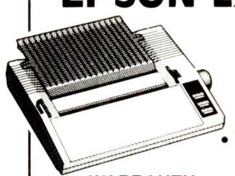
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Inquiry 293

CONVERSATIONS

BY DOUGLAS E. COMER AND LARRY L. PETERSON

An alternative to memos and conferences

This article is based on excerpts from a paper entitled "Conversations: An Alternative to Memos and Conferences," which was presented at the Workshop on Computer Conferencing and Electronic Messaging, University of Guelph, Canada, January 22–23, 1985.

A CONVERSATION-BASED SYSTEM groups messages into conversations, with messages within a conversation ordered according to the context in which they are written. Message context defines a relation between messages that makes it easy to implement conversations in a distributed environment.

DATA STRUCTURE

The underlying structures that support both the memo-based system DRAGONMAIL and teleconferencing systems are the mailbox and the conference, respectively. Simple interfaces, such as the UNIX mail system, place saved messages in a named file. Other interfaces, such as MH, MS, and Laurel, provide more advanced mechanisms for archiving messages, such as "folders" into which messages are filed. Commands allow the user to browse through the hierarchy of saved messages and select particular messages based on a specified attribute-value pair. User interfaces like Edmas and AUGMENT use the technique of "linking" related messages, providing yet another mechanism for allowing the user to traverse through a list of messages and replies to messages.

Despite their differences, all conventional user interfaces are founded on a memo-based model that resembles the office practice of memo communication. A new model for exchanging information combines the memo-based model and the teleconferencing model. This approach replaces the first-in/first-out ordering of memos with a mechanism that groups messages into conversations and orders the messages within a conversation according to the context in which they were created. This model places a high-level structure on messages, where the fundamental object of communication is the *conversation* rather than the memo. Instead of reading, writing, and filing individual memos, users participate in a set of conversations.

THE UNDERLYING MODEL

A conversation consists of a group of *messages*, denoted $M = \{m_i \mid i>0\}$, shared by a set of *participants*, denoted $P = \{p_i \mid i>0\}$. Also associated with a conversation is a *topic* defined by the user who starts the conversation. A topic is a short phrase that describes the conversation's general area of discussion.

Participants *view* the messages associated with a conversation as well as add new messages. In this system, participants *submit* messages to a specific conversation rather than mail them to a set of recipients. A conversation begins when a user defines the set of participants P and submits an initial message m_0. New members are added

(continued)

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Larry L. Peterson received his Ph.D. in computer science from Purdue University, where his thesis investigated issues in electronic mail systems. He can be contacted at the Department of Computer Science, University of Arizona, Tucson, AZ 85721.

to a conversation by having the list expanded to include them. Similarly, old members may be removed. Being added to a conversation means having access to the entire *history* of the conversation (i.e., all of set M). Removal implies not being able to read any further messages submitted to the conversation. The system also allows users to manipulate entire conversations; a user can *delete* an unwanted conversation, as well as *merge* two related conversations and *split* a diverging conversation.

The conversation-based system partitions messages in a conversation into *visible* and *hidden* subsets. The system automatically displays visible messages to participants when a conversation is viewed. Hidden messages are maintained in the history of the conversation and can be viewed by users via special commands. Participants may *hide* messages determined to be irrelevant to the conversation and *supersede* a group of messages with a single summarizing message.

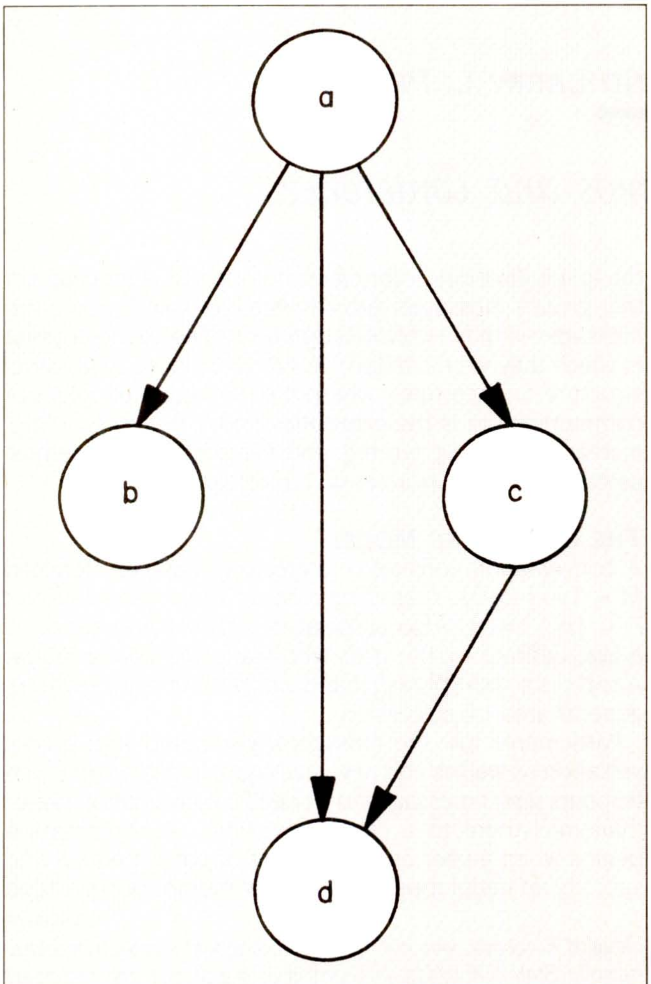


Figure 1: *A context graph for a conversation in which message a was the initial message of the conversation. Messages b and c were submitted after their respective authors had read message a, but independently of each other. Message d was submitted after its author had viewed messages a and c but before he had viewed message b.*

MESSAGE STRUCTURE

An individual message in a conversation consists of a *header*, a *body*, and a set of *attachments*. The header consists of the *sender* of the message, the creation or *date* of the message, and the *subject* of the message. The header may also contain a set of *parameters*, including the *urgency* and *lifetime* of the message.

The body of the message contains the lines of text meant to be viewed by the participants. Along with the text, a user may send a set of attachments with the message. Attachments might be binary programs, source programs, or data files that are not necessarily meant to be viewed by participants. Instead, participants remove attachments from the message and place them in files for further computation.

PARTICIPANT HIERARCHY

Participants in a conversation are categorized according to their privileges within the system. Here are the classes of participants and their respective privileges:

Reader: A participant who is only allowed to read messages in a conversation.
Contributor: A participant who reads and also has the right to add messages to a conversation.
Administrator: A person who can remove or add participants as well as move irrelevant messages into the set of hidden messages.
Owner: The person who starts a conversation. In addition to having administrative authority, the owner has the right to extend or restrict the privileges of other participants.

MESSAGE CONTEXT

The underlying structure of a conversation maintains the relationship among the messages that make up the conversation. Informally, when participants compose a message, they do so in the context of the messages they have already seen. Specifically, *message context* is a relation R that holds between messages i and j such that $m_i\ R\ m_j$ if and only if m_i had been read by the author of m_j before composing m_j.

The set of message-context relations for the messages in a conversation is represented by a directed acyclic graph called a *context graph*, denoted $G = (M, E)$. The vertices of G correspond to the messages in the conversation, while the edges of the graph represent the message-context relation. An edge leading from node i to node j implies $m_i\ R\ m_j$ and reads "m_i precedes m_j." Figure 1 is an example of a context graph.

Associated with each participant p_i is a subset of M, denoted $\overline{M}_i$, corresponding to those messages in M

(continued)

Conversations move into the background after n idle days, whether a participant has viewed all the messages there or not.

already viewed by p_i. We informally think of the context graph as having each node marked according to whether or not each participant has read it. Thus, when participant p_i views a message, the message is added to $\overline{M}_i$, and when p_i submits a message, it is connected to the context graph by edges leading from all the vertices in $\overline{M}_i$.

The messages in the graph are arranged topologically. Thus, if message m_j was composed by a participant after reading message m_i, then m_i is displayed to those viewing the conversation before m_j.

Anytime a user participates in a set of conversations, denoted $K = \{k_i | i \geq 0\}$, he or she defines subsets of K by supplying a *subset name* and specifying the conversations in K contained in the subset. (We represent the subset named S as K_S.) Defining subsets of conversations allows the user to treat a group of conversations collectively.

In addition to user-defined subsets of K, conversation-based mail maintains a collection of system-defined subsets. For example, the system partitions K into *foreground* and *background* subsets, denoted K_F and K_B, respectively. Conversation $k_i \in K_F$ if and only if a participant has acted on it in the last n days.

The system also partitions K into the subset of conversations that contain messages not yet seen by the user, denoted K_N, and the subset of conversations in which the user is up to date, denoted K_C. Finally, K_U denotes the set of conversations containing unread urgent messages. $K \subseteq K_N$, but $K \not\subseteq K_F$ because conversations move into the background after n idle days, whether a participant has viewed all the messages it contains or not.

Distributed System Implementation

We abstractly view a conversation as having a single context graph. But because users expect a fast response time when viewing messages, a single graph is not practical if the participants in a conversation are distributed over two or more computer systems with inherent communication delays between them.

Therefore, each participant p_i is seen as having a resident copy of a subgraph of G, denoted G_i, that is quickly accessible for viewing. When participant p_i views the messages in a conversation, he or she sees only the messages

(continued)

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> DRAGONMAIL *is configured to run on three* VAX/UNIX 4.2BSD *computers connected by a* 10*-megabit token ring; the source code is written in* C.

that are contained in G_i, where $M_i \subseteq M$ is the set of messages resident at p_i's system, and $\overline{M}_i \subseteq M_i$. Furthermore, when p_i submits a message, that message is added to G_i and the system propagates the update to all the other participants' copies to effect the change to G previously described.

Specifically, when p_i submits message m_{new} to a conversation, a new node is first attached to his or her graph G_i and then to each remote copy of G. Updating a graph involves transporting information over computer networks. Because of varying communication delays between computers, however, it is possible for p_i to receive a message, read it, and respond to it before p_j receives the original message.

Thus, we must ensure that all the nodes to which m_{new} connects are also present in G_j. That is, the operation of adding m_{new} to a given G_j is blocked until each node that precedes m_{new} is present in G_j. Finally, because a path from each message that precedes m_{new} is sufficient (rather than a direct edge), we require that the new message be attached only to the *leaf* vertices of M_i, thereby reducing the overhead of adding new nodes to a context graph.

THE PROTOTYPE

A prototype conversation-based mail system called DRAGONMAIL is being used as part of the TILDE project at Purdue University. DRAGONMAIL currently serves over 100 users and a dozen groups in the Computer Sciences Department and is configured to run on three VAX/UNIX 4.2BSD computers connected by a 10-megabit token ring. The DRAGONMAIL source code is written in C and is approximately 6500 lines long.

DRAGONMAIL's user population is distributed over three hosts, with a particular host designated as each user's home machine. Each host maintains a copy of all conversations in which the residents of that host participate. Also, a single copy of the context graph is replicated on each host for each of its resident participants.

When a user invokes an operation that alters a conversation, the local version of DRAGONMAIL distributes the change to the home machine of each participant. At each destination host DRAGONMAIL then makes appropriate

(continued)

A DRAGONMAIL CONVERSATION

CONV	TOPIC	NEW/TOT
1	TILDE reports	0/15
***2**	**Do What I Mean**	**2/4**
***3**	**Dragon Bugs**	**3/10**
4	Ethernet on 8086s	0/18

Figure A: *Screen display after initiating a mail session. The Topic column contains a brief synopsis of the conversations shown. The lines in boldface are highlighted on the screen to indicate that the conversation contains an unread message. Conversations marked with an asterisk contain urgent messages. The user selects a conversation by entering the corresponding number in the command window.*

Conversation 2: Do What I Mean

MSG	Synopsis
1	**Chris / 5-16 9:30 / CR**
2	Steve / 5-17 8:44/ Control L
*3	Doug / 5-17 18:50 / More on CR
*4	Tim / 5-17 19:31 / I disagree

Figure B: *Screen display after selecting conversation 2. This time the user selects message 1 via the command window. Note that the ID of the conversation is displayed in the upper window. Unread messages are in boldface. Previously read messages appear in this display to give surrounding context to new messages. Operations such as* list, add, *and* delete *participants can be executed at this level.*

```
Conversation 2: Do What I Mean
Msg 1: Chris / 5-16 9:30 / CR

Instead of returning to the conversation level, carriage return
should do what I mean (DWIM)—automatically display the next
unread message.

Cheers,
Chris
```

Figure C: *Screen display of conversation 2. Note that at this level conversation ID and message ID are displayed in the two upper windows. Executing an* S *(submit) command at this point puts the user in the edit mode. An* H *(help) command may be executed at any point in the process and will display the command syntax for that level.*

changes to its copy of the conversation.

Information is distributed between copies of a conversation through the existing mail-transport system, SENDMAIL. DRAGONMAIL was implemented on top of the existing message-transport system because the component hosts do not share a common transport-level protocol. The "sending" DRAGONMAIL encapsulates the message and header lines inside a "standard message." Specific header lines are added to the regular header, and other data is placed within the message body.

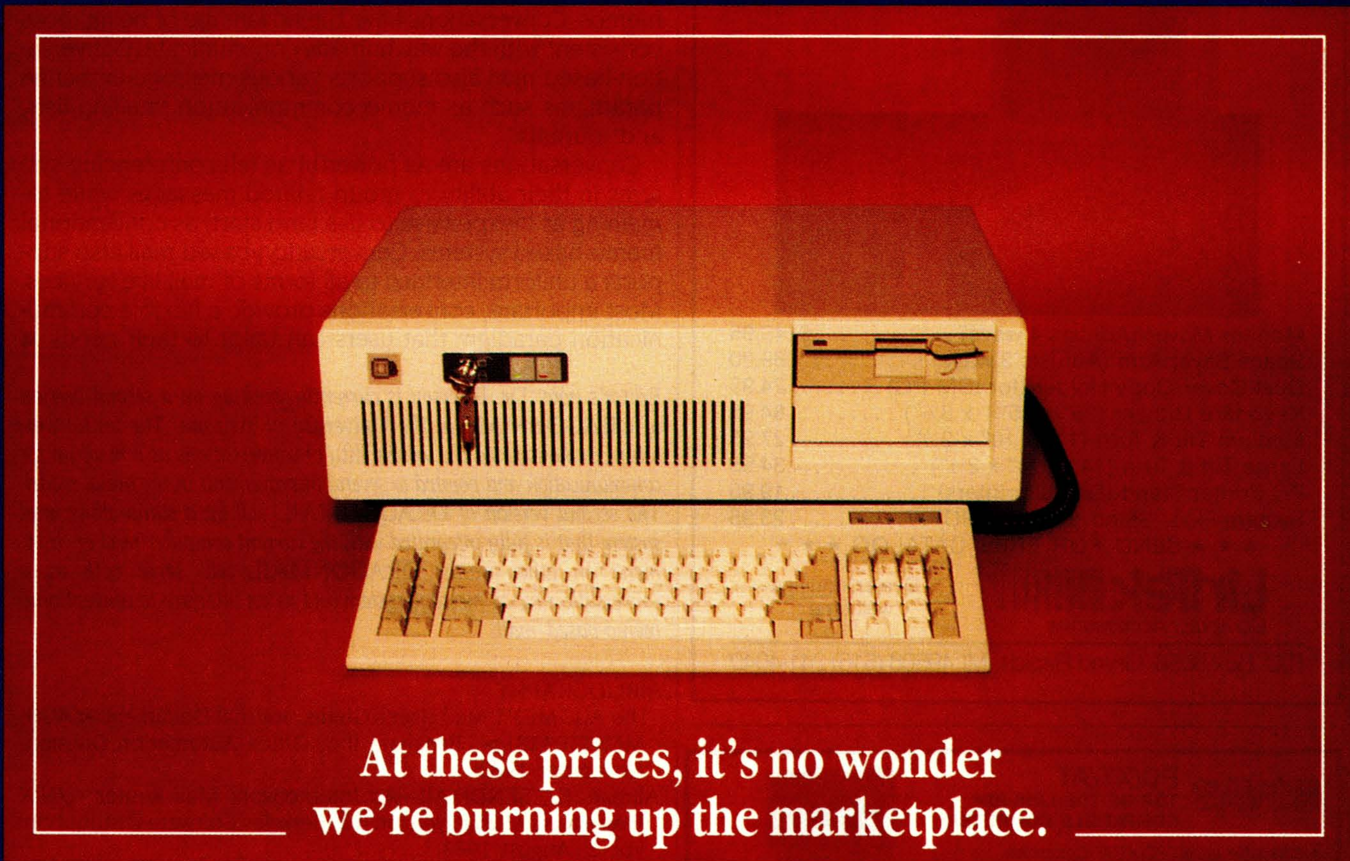
When a message arrives at a remote copy of the conversation, the local DRAGONMAIL updates its copy of the context graph associated with that conversation. If the message cannot be added to the local copy of *G* because the messages that precede it are not present, then the message is placed in a queue. As additional messages arrive, DRAGONMAIL checks the queue for messages that can be added to *G*.

Because the message-transport system occasionally loses messages, queued messages "timeout" after a period of time, and the local copy of the conversation is refreshed by requesting the conversation's history from the home host. Figure A shows a typical screen display when a mail session is initiated. Figure B shows the display when a specific conversation ("Do What I Mean") is selected. Figure C is the display of the actual message viewed in the conversation "Do What I Mean."

We have described a new high-level computer mail service based on conversations rather than independent

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memos. Conversations have the advantage of being more consistent with the way humans communicate. Conversation-based mail also supports various message-exchange paradigms such as memo communication, mailing lists, and journals.

Conversations are as powerful as teleconferencing systems in their ability to group related messages while remaining as inexpensive to use (and start) as conventional memo-based systems. Conversation-based mail also supports a uniform interface to all forms of mail-like services. Most important, conversations provide a flexible communication paradigm that users can tailor to their needs. ■

Editor's note: Dr. Peterson is currently working on a second version of DRAGONMAIL *at the University of Arizona. The initial prototype demonstrated the workability of conversations as a medium for communication and pointed to several improvements in the initial model. The second version of* DRAGONMAIL *will be a stand-alone mail system that is fully integrated with the current computer mail environment. In other words,* DRAGONMAIL *will serve both as a conversation-based message system and as an interface to conventional memo-based mail.*

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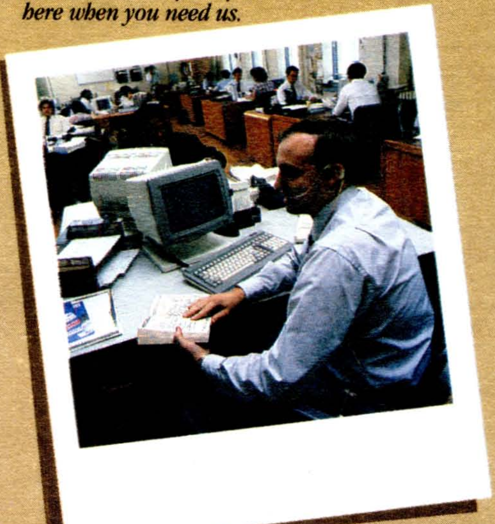
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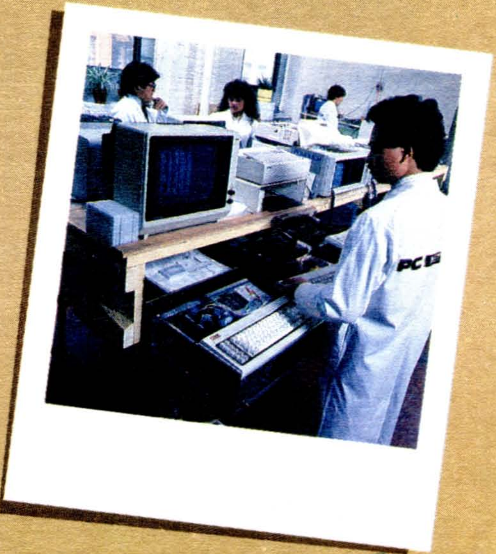
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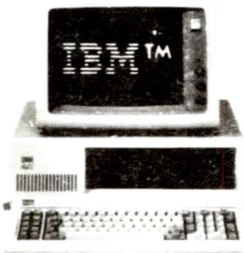
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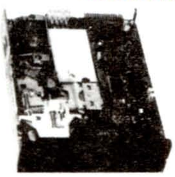
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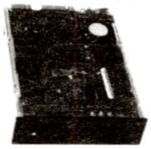
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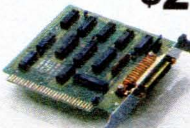


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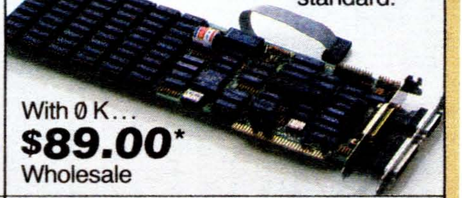
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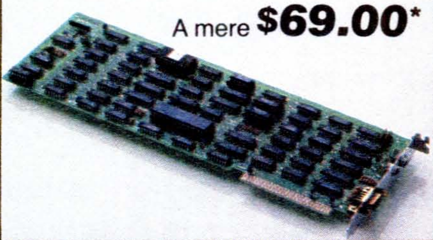


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CROSS-SYSTEM CONFERENCING WITH CLACR

BY SHERWIN M. LEVINSON

Microcomputers may offer a way to link systems and cut costs

MOST PEOPLE HAVE probably used one or more electronic mail systems, bulletin-board systems (BBSs), or computer conferencing systems (CCSs). As on-line communications systems proliferate, many barriers make it difficult for any individual to regularly use more than a few of them. If you know people on several different systems, it may be hard to keep track of who is on which system. Also, command structures are inconsistent from one system to the next. Then there's the cost. To reach all the people you want, you need to access a number of systems that may charge for connect time, involve extra phone charges, or both.

By linking systems you could have a broader base of potential conference participants without the difficulties described above. You could communicate with a large pool of people who closely match your own specific interests without having to remember which system they are on or what the command structure for that system is. Any solution to the problem of linking systems must also take cost factors into account and provide an affordable means of communicating across systems.

What I propose is a personal computer communications program that provides timed automatic log-on to multiple systems, offers an index of incoming messages according to prespecified categories, and allows the organization of computer conferences that span multiple BBSs, CCSs, and electronic mail systems. Cross-system conferences should be accomplished with no additional effort on the part of the conference's organizer or any of its members by porting the conference entries from each host system to all of the other systems where the conference is taking place.

I call the proposed software I will describe here the Conference Linker and Cost Reducer (CLACR). As the name implies, CLACR (pronounced "clacker") is intended to link conferences taking place on separate systems and to reduce the cost of using messaging systems. It also aims to address the other barriers to use described above.

The design goals for a full implementation of CLACR are as follows:

1. To make possible a computer conference whose participants span several different computer conferencing systems.
2. To make possible true computer conferencing on BBS and electronic mail systems.
3. To reduce the cost of participating in computer conferencing; especially, to reduce the cost sufficiently to make up for the additional cost of copying conference entries from one system to another.
4. To make participation on numerous different systems easier by providing a consistent user interface; to make that interface one that can be tailored to each user's preference.
5. To make the process of composing, sending, retrieving, and organizing messages easier.
6. To let users communicate with any other users without needing to remember what conferencing systems

(continued)

After a 13-year management career, Sherwin M. Levinson left big business to devote full time to his consulting practice. He can be reached at POB 888231, Atlanta, GA 30356.

they are on or what IDs they use on those systems.
7. To operate effectively without any changes required to the host messaging systems themselves.

The list is certainly ambitious, but it's quite possible to do using established programming techniques.

To accomplish these goals, CLACR must maintain a database containing several different tables of information. These are System Data for each remote system used, User Data for each user involved in correspondence, Conference Data, Message Pointers, Message Text, Inbox pointers to messages received but not read, and Outbox pointers to messages to be transmitted (see tables 1 through 7 for detailed contents). These tables contain the information CLACR needs to achieve its goals.

Table 1: *The System Data table contains essential information about each remote system.*

Internal system code
For each access method (different networks, direct dial):
  Phone number
  Sequence required to connect to target system
  Unique costs
Log-on sequence (account, password, etc.)
Type of system (BBS, CCS, or electronic mail)
Commands to reach BBS, CCS, or electronic mail system
Cost details by data-transfer rate, time of day, day of week, etc.
Holiday schedule
Downtime schedule
Activity history
Effective data-transfer rate history
Cost history
Maximum weekly cost
Use history (e.g., average messages retrieved per session)
Desired frequency of message retrieval
Command translation table

Table 2: *The User Data table contains necessary data for each person involved in correspondence.*

Internal user code
User nickname
"Real" name
For each system where this user is active:
  Internal system code
  The user's name on that system
Optional: address, phone numbers, comments, etc.

Table 3: *The Conference Data table contains all the information necessary to organize and manage a conference. Message number and author's internal user code together uniquely define this conference and point to the text of the opening statement stored in the Message Text table.*

Message number
Author's internal user code
Conference nickname
List of addressees and system where each invitation was sent
Public or private
List of joiners and system from which each joiner participates
List of conference organizers

MESSAGE FORMAT

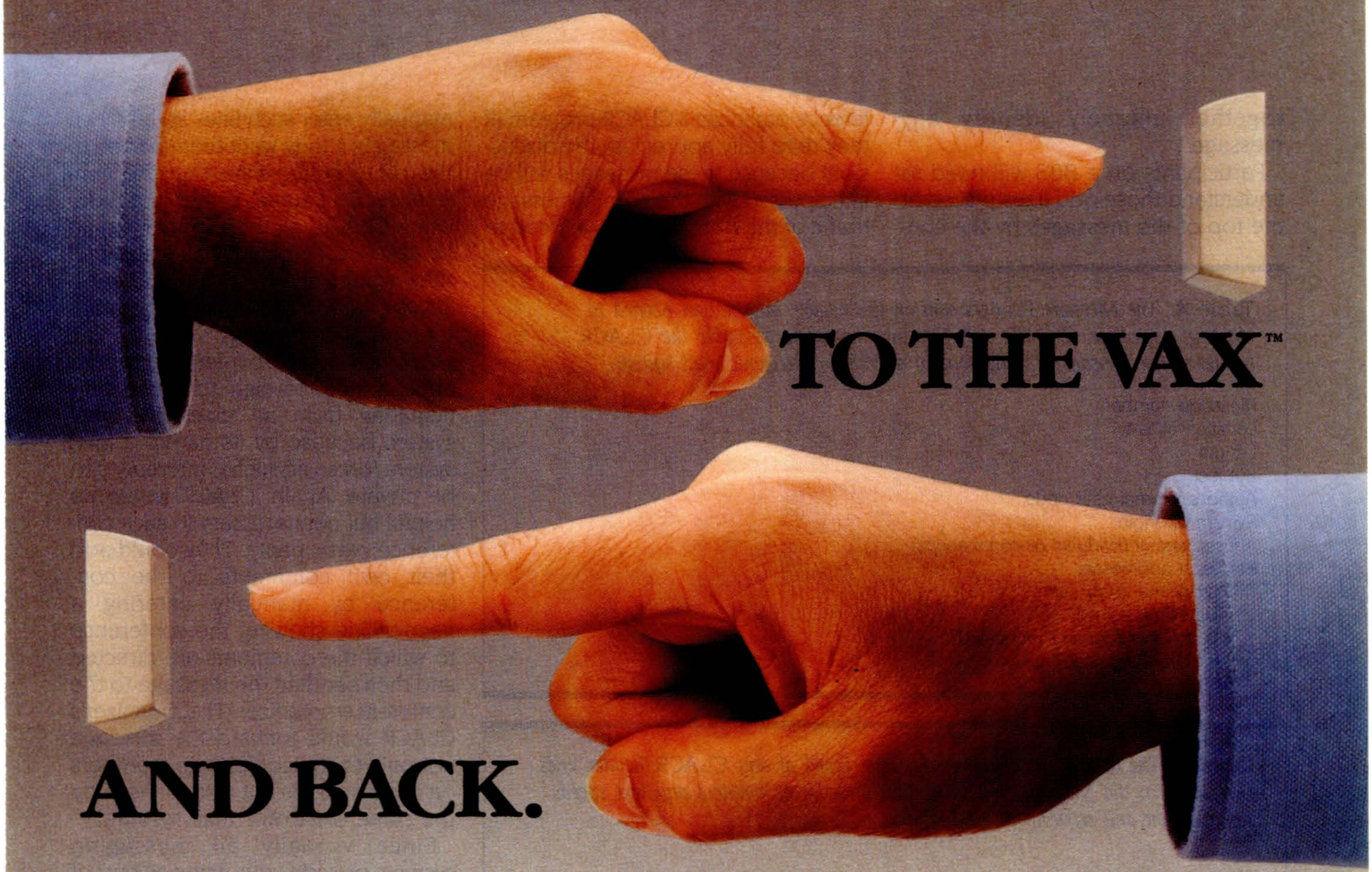
CLACR is to be designed so that the organizer of a cross-system conference is the only one who absolutely must have CLACR. In fact, members of the cross-system conference who participate in a computer conferencing system don't even need to know that there's anything unusal about their conference; to them it will just seem that there's a higher level of activity than usual and they'll notice that some of the entries have a few odd lines at the top.

CLACR expects the first couple of lines of the body of each cross-system conference entry to conform to a specific format. The standard CLACR message format can be used on any messaging system and provides information about message routing and message type on the first line of text. Messages imported by CLACR also contain a second line describing the origins of the message. Because the CLACR header information is part of the message text as far as the host system is concerned, CLACR messages are totally transparent to the host system. This scheme doesn't significantly detract from the message's readability for those not using CLACR, and it allows CLACR to scan messages as they're being received to determine if they are to be saved by CLACR.

Message types include the following: conference entries, requests to join, requests to leave, conference invitations, requests for a joiner list, and private messages. As shown in table 4, each message pointer contains a message number and message author. If individual systems cannot be relied on to provide some message identification that is at least unique to that author on that system, CLACR could provide message numbers such that the message number and message author information

(continued)

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together uniquely identify any message.

Participants on a BBS will need to understand those odd lines placed at the top of the messages by the conference organizer's CLACR program (if they're to fully appreciate the discussion) because these messages will be interspersed with the normal message traffic of the BBS. They'll also need to manually enter such lines in their own messages if they want them ported to the other systems hosting the conference. Of course, if they too were using CLACR, all these things would be taken care of automatically and they would receive their BBS messages organized by conference rather than strict chronology.

A cross-system conference would appear most foreign to those participating from an electronic mail system because by its nature a mail system forces all such conferences to be private. Again, CLACR would be helpful but not necessary to such conference participants. They could add their own comments to the conference by manually entering a header line showing the conference to which the comments are directed and then sending the message to the conference organizer. The organizer's CLACR would forward the message not only to the conference members on other systems but also to those on the same electronic mail system.

Since virtually all messaging systems provide your name as part of the message header, this need not be repeated on the first line of the text. (For internal purposes, once a message has been received, CLACR uses the unique internal user code as found in the User Data table based on the system of origin and the message author's name on that system.) The first line of text in a message conforming to CLACR's specifications contains a two-character combination identifying a CLACR header line, message-type code, message number, message number of target conference, urgent flag, reply-requested flag, acknowledgment-requested flag, type-dependent information such as subject or title of conference, and checksum (optional if the header was created manually).

The actual messages received during a connect session are scanned as they are received to check for a CLACR header line. If the CLACR header line is present and contains a checksum, the checksum is verified; if verification fails, CLACR requests the

(continued)

Table 4: *The Message Pointers contain the header information needed to identify a message.* CLACR *uses this information to assemble the* CLACR *header if the message is being sent to a* BBS *or electronic mail system.*

Message number
Location of text
Length
Subject
Author's internal user code
System of origin
Addressees (individuals or conferences)
For each addressee:
- Date/time to be sent
- Date/time actually sent
- Is acknowledgment requested?
- Is reply requested?

Table 5: *The actual text of a message is stripped of any* CLACR *header lines and stored in the Message Text table. Use of separate pointers and text speeds identification and retrieval of message text.*

Message number
Length
Text

Table 6: *The* CLACR *Inbox contains pointers to messages received but not yet read.*

Message number
Location of text
Length
Subject
Author's name on system of origin
System of origin

Table 7: *The* CLACR *Outbox contains pointers to messages to be transmitted.*

Message number
Location of text
Author's name on destination system
Destination system
Addressees (individuals or conferences)
For each addressee:
- Date/time to be sent
- Date/time actually sent
- Is acknowledgment requested?
- Is reply requested?

system to resend that particular message. Once a valid CLACR header line has been received, the message is saved if it is directed to a conference that is organized or joined by the owner of this CLACR system. CLACR also checks if the acknowledgment-requested flag is on and, if so, immediately places an acknowledgment-of-receipt message in the Outbox.

If there is no CLACR header line present, CLACR can scan the entire text for sets of keywords that you have specified to identify non-CLACR messages of interest. In this way CLACR could even scan for messages that might be relevant to ongoing conferences. It might also be desirable to allow a provision to always skip messages that contain certain keywords or were authored by certain users.

Once all incoming messages have been received, CLACR reviews the contents of the Outbox and sends all messages that are destined for this system and that do not indicate a delivery date and time later than the current date and time. As each message is sent, it is removed from the Outbox. This is also when any special commands are sent to the host system for execution; these would include such functions as deletion of old entries, modification of access permissions, modification of conference joiner lists, and so on.

CLACR adds a second header line to the messages it ports to other systems. This line identifies the author of the message, the system where it originated, and the date and time of its entry.

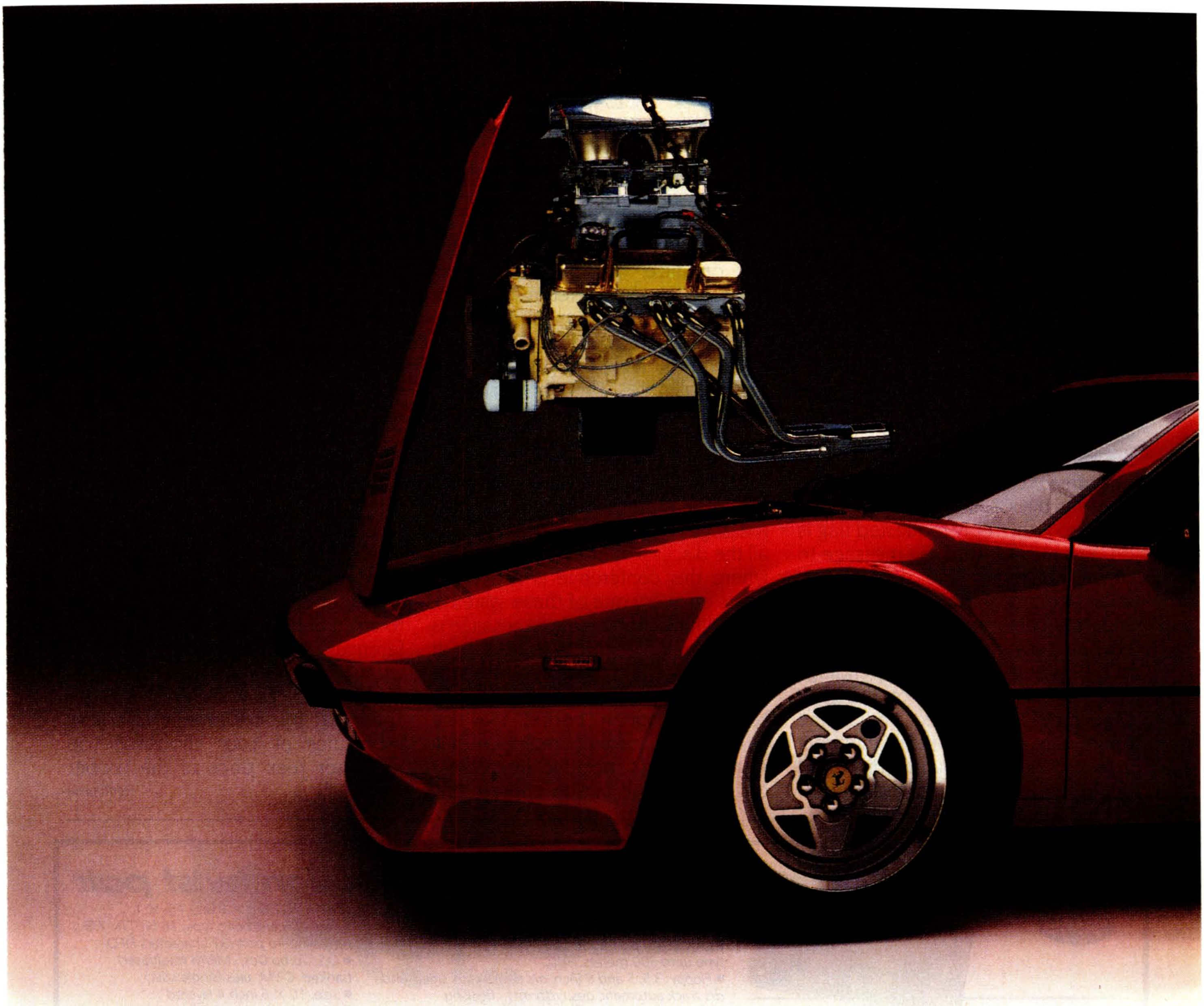
INBOX PROCESSING

While CLACR is connected to a remote system, messages that are to be saved are placed in an input buffer where they're held until after CLACR disconnects. They are then scanned to create the Inbox, Message Pointer, and Message Text entries as well as a portion of the Outbox. The Outbox is key to cross-system conferencing because through it conference entries made on one system get to all the others where the same conference is active.

Likewise, special CLACR messages representing requests to join or leave a conference or to get a copy of the full list of conference members are processed at this stage. Exactly how these are processed depends on the types of systems where the conference is active (BBS, CCS, or E-mail) and whether the conference is public or private. These concepts are discussed further in the next section.

When input-buffer processing is complete, you are notified that there are messages in the Inbox. These may be retrieved in various ways, including by keywords, by author, by subject, by system of origin, and by conference.

(continued)



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Inquiry 284

The number of messages falling into each of these categories may also be displayed. You may store several standard Inbox processing methods and choose the desired one each time the Inbox is reviewed.

As each message in the Inbox is displayed, you may compose a reply and specify that it be directed privately to the message author, to the conference, or both. Of course, it's not necessary to reply, but CLACR will remind you to do so if the reply-requested flag is on. You may forward the message to other individuals and conferences, adding comments if desired. The message may also be left in the Inbox, either specifying a category or having it by default held in a "pending" category. Finally, action on the message may be deferred until some future date and time, in which case it is kept in the Inbox but not displayed until the specified date and time.

For each message in a conference you organize, you are asked if the message is to be ported to the other systems where the conference is active. While porting would normally be chosen, you have the option of not porting all notes. This can help avoid duplication and keep costs down. If porting is approved, appropriate Outbox pointers are created. Then the next time CLACR is connected to each of these systems, the appropriate messages are transmitted. In this way all the discussion from all the systems where this conference is active appears on every one of these systems.

The final action on each message is to specify whether it is to be kept in the Message Text table (and Message Pointer table) or purged. If it is to be kept, a retention period may be specified; a default retention will apply if none is specified. Regardless of the retention period chosen, any message for which an Outbox entry exists will be held until the Outbox entry is cleared.

A simple full-screen editor would be available when you want to enter replies and new messages. Since messages destined for electronic messaging systems are usually brief, the CLACR editor is relatively unsophisticated. Still, it would be far more usabie than the line editor typically found in messaging systems, and it would be easier to learn, since the same editor would be used for all systems.

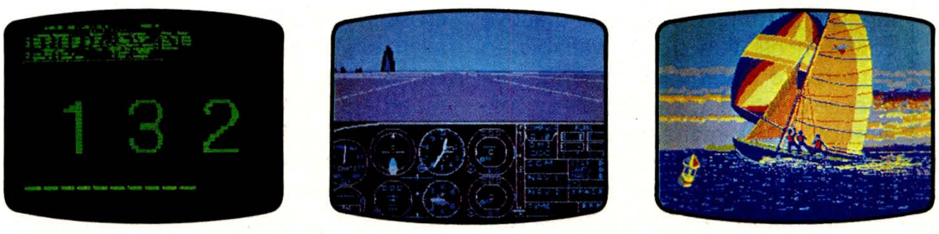
New messages may be addressed to any combination of users and conferences. And here is where one of CLACR's most valuable features comes into play. Addressees are specified by conference or user nicknames of your choosing; you need not keep track of the proper

(continued)

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destination systems—this information is retrieved by CLACR from the User Data and Conference Data tables. Either of these tables could be scanned through windows during message creation and editing.

CROSS-SYSTEM CONFERENCING

Several concepts have already been alluded to without being fully explained. There are certain basic functions present in any viable computer conferencing system regardless of what the system authors choose to call these functions. So while one system may use the command COMPOSE, another WRITE, and a third SAY, all three mean the same thing: Accept text that, once entered, is to be made available to particular other users of the system. This function requires that the system be told to whom the text is to be made available, the subject of the transmission, and the text itself.

Recognition of the list of basic functions is essential to our design because CLACR must provide a way to accomplish each of these on any system it uses. The basic functions available to all users include message creation, message addressing, message retrieval (both new and previously received), message deletion, joining and leaving conferences, accessing lists of joiners, and finding active conferences. Functions available to conference organizers include conference creation, management of conference access, management of retention periods, and deletion of conferences and individual messages.

That is far from a complete list, but it conveys the idea of what basics must be accomplished in any viable conferencing system. Some of these basic functions assume other components. For example, message creation assumes the ability to edit text that's already been entered, to retrieve and use text of previous messages, to forward received messages to other users, and so on.

THE USER INTERFACE

The first step in designing CLACR's user interface is to provide a CLACR command for each of the basic functions. Ease of use dictates typical design considerations such as the ability to perform any function with a single command, the ability to provide user-defined synonyms for each command, recognition of the shortest unique abbreviation for commands, display of a list of possible choices when a nonunique abbreviation or possible misspelling is entered, the availability of context-sensitive help, and, perhaps, a dual menu-driven and command-driven interface that lets you graduate to the briefer command-driven interface (once you have learned the command set) but still provides guidance when needed.

The set of basic conferencing functions is directly available on a computer conferencing system. However, if you are to extend conferencing to BBS and mail systems, the effects of some of these commands must be synthesized. Further, for a conference that spans several systems, even if these are computer conferencing systems, some of the native commands would not reflect the full extent of the conference. For example, the command to display the list of those who have joined the conference would only display those members who reside on that particular system.

The most important aspect of a cross-system conference is making available to all the members of the conference the entries of all other members. This is relatively easy. As part of Inbox processing, when CLACR receives entries in any conference, the Conference Data table is scanned to determine if you are the organizer of that conference. If not, the entry is handled as any normal received entry. But if you are the conference organizer, then (with your permission) pointers are added to your Outbox indicating that this entry is to be sent to each of the other systems where this conference resides. If a target system is a traditional electronic mail system, a mailing list is created using the list of joiners from the Conference Data table.

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(continued)



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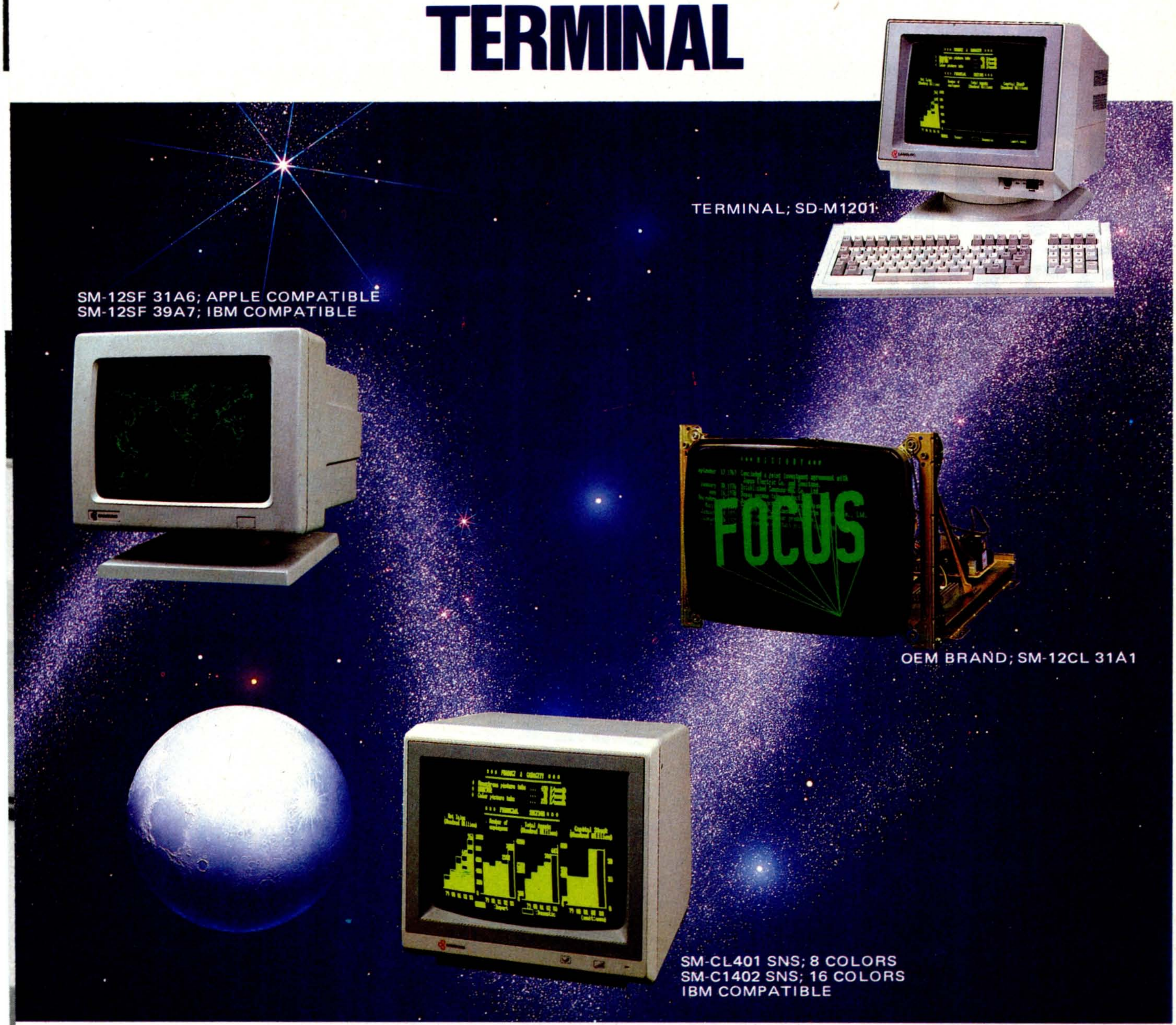
urgent. That way you can take note of any changes in the remote system's prompts or responses, any special announcements about downtime or access numbers, or any failures in the automatic message transmission and retrieval and take corrective action if necessary. While some of these exceptions can be eliminated by error-correcting protocols like X.PC, exceptions such as system announcements cannot.

Whenever a choice is available, CLACR should be set up to use the "brief" or "expert" modes of the target systems, thereby minimizing the number of characters transmitted and received and, consequently, the cost of connection.

CONCLUSION

Of course, the proposed CLACR software would still require some human intervention. But I believe it would make cross-system conferencing possible at a lower cost and with far less effort than with any existing microcomputer software package. At the time of this writing, CLACR is no more than a dream. But if other people find the idea anywhere near as exciting as I do, it may soon be a reality, opening the benefits of computer conferencing to thousands and even millions who previously found it too complicated or too expensive. ■

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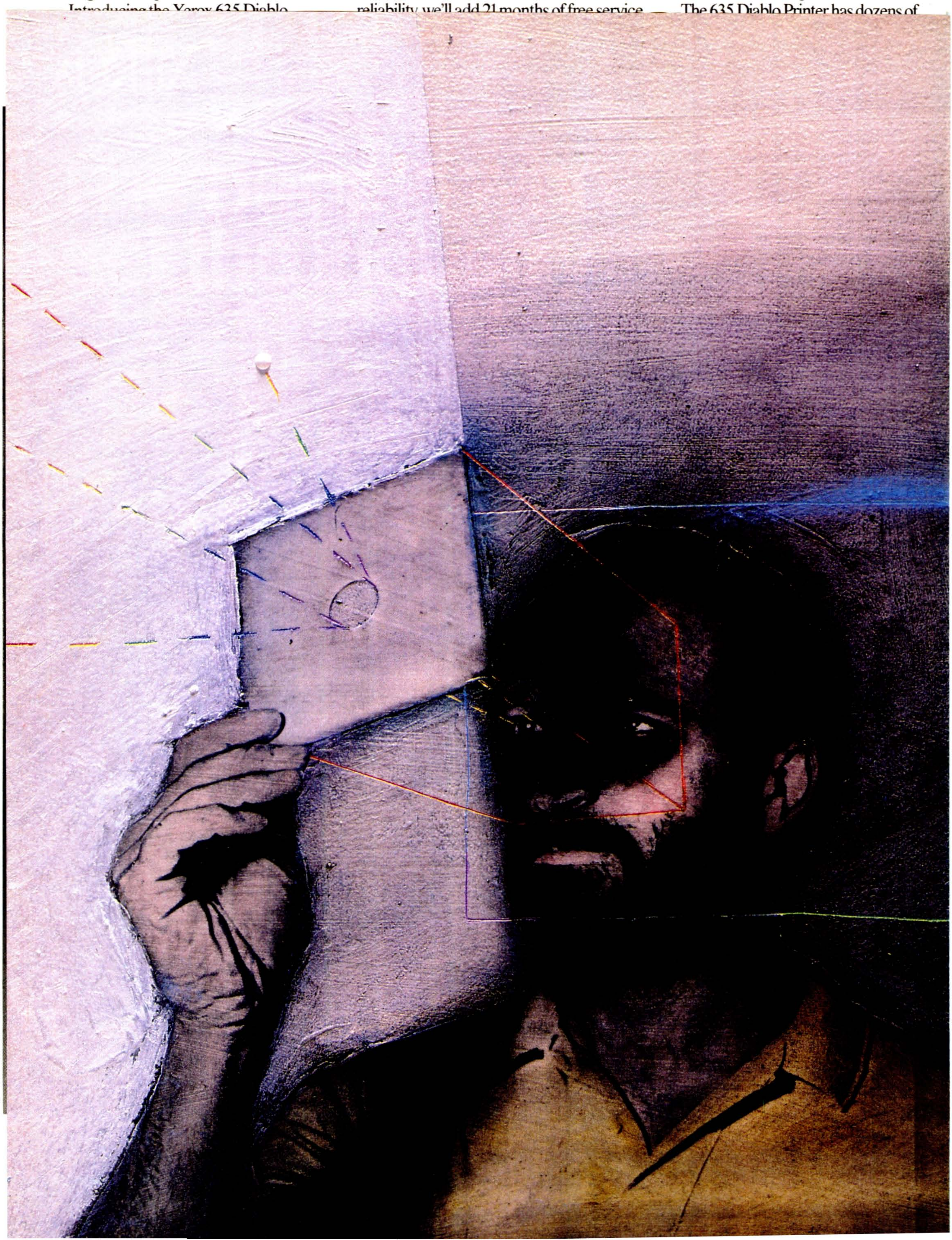
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Reviews

AT&T'S PC 6300, designed jointly by AT&T and Olivetti and manufactured by Olivetti, is fast, expandable, compatible with IBM PC software, and less expensive than the IBM product. Bob Troiano has taken a look at this machine and reports his findings in this month's first review.

Two laptop computers are compared by Harry Krause. Both the Tandy 200 and the NEC PC-8401A are flip-top LCD-screen portables with generally closed architectures. Each weighs between four and five pounds, uses a Z80-equivalent microprocessor, and may be operated on battery power. NEC has slightly modified its offering since this review was written. Chiefly, the Japanese laptop now has a series of click-stops built into the cover/screen's hinges as it folds back. This allows you to have more confidence in the screen staying where it is positioned. The unit is not, however, different in any substantive way from the one described in this review.

Golden Common LISP from Gold Hill Computers is an extended subset of Common LISP. It supports more than 400 primitives and includes stack groups, macros, closures, streams, and other advanced LISP features. In fact, this language implementation gets high marks from reviewer Bruce D'Ambrosio in just about every area.

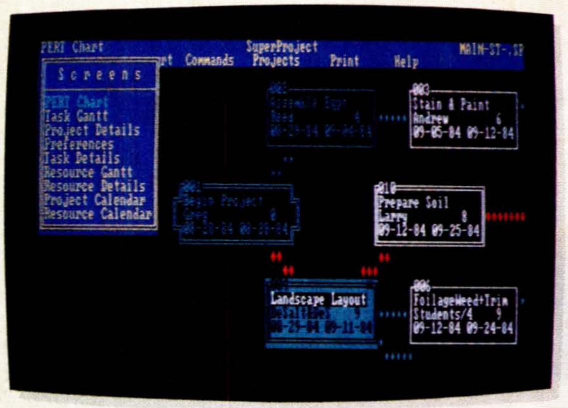
Rubin Rabinovitz takes a look at Peter Norton's data-recovery tools, the Norton Utilities. Mr. Rabinovitz describes types of data destruction and tells how the program gets your information back. Losing data is common enough, and infuriating enough, that this review should have a helpful tip or two for almost everyone.

Next, Gregg Williams, BYTE senior technical editor, takes a look at General Computer Company's HyperDrive hard-disk upgrade for the 512K-byte Apple Macintosh. Mr. Williams reports that, true to its promise, the HyperDrive is fast, unobtrusive, and easy to use. Less heartening, however, is a series of problems he encountered with the unit.

Back when the Radio Shack Model 100 was new, it was praised for being the only true laptop portable computer but criticized for its lack of hardware expandability. Since then, options have been introduced that let you increase memory, add disk drives, increase the display size, and add interface expansion boxes. In his review of "Upgrades for the TRS-80 Model 100," Terry Kepner takes a look at several products now available for the pioneer laptop and provides his assessment of their usefulness.

BYTE's New York editor, Rich Malloy, delivers his analysis of IBM's Proprinter. This unit lets you print fanfold and single-sheet paper, as well as envelopes, without going through several time-consuming paper changes.

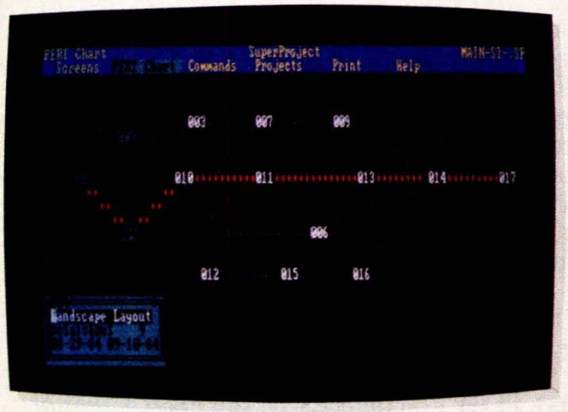
Jon Edwards, one of our staff's technical editors, takes a close look at Panasonic's 4-Color Graphic Penwriter. At first glance, you'd think this was one of the newer electronic typewriters. Then you notice that it uses pens and is actually a writing typer. Portable, multifunctional, and shipped with built-in graphics programs, the Penwriter has a number of characteristics that make it worth considering.



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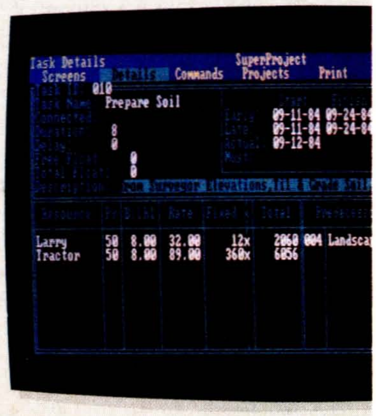
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Apple's enhancements for the IIe and IIc consist of a color monitor, a 3½-inch disk drive, a 300/1200-bps modem, and a memory-expansion card. The color monitor gave us no surprises. It worked right out of the box and provides a good-size focal point after using the smaller IIc monochrome screen. The monochrome unit, however, has a crisp, bright, high-contrast display. The color monitor is pale, with shades more like pastels than bold primary colors.

I don't feel it can be used comfortably with text. With the lack of sharpness common to any color monitor and the muted shades provided by the Apple palette, I have some difficulty keeping my place as I work.

In spite of its shortcomings, the color monitor at least worked. The 3½-inch disk drive didn't work at all. After being plugged in, it simply disappeared as far as the computer was concerned. We found later that you need either ProDOS version 2.0 (or later) or the Apple IIc Add-On Kit enhancement to make the Unidisk visible to the computer. This information, however, was contained in a manual for "Apple Access II on the Unidisk," rather than in any information about the disk drive itself.

The manual packed with the unit was disappointingly uninformative. However, you will observe that the documentation provides the same sketchy generalities in English, German, Italian, Spanish, and French. Getting precious little to go on in five languages was not as helpful to me as getting details in one language.

Apple's new modem is a half-size 300/1200-bps unit. There is a circular seven-pin socket for the serial communications cable on the modem itself, but you can get a variety of interface cables to connect this modem with Apple computers other than a IIc. Interface cables must be purchased separately. The technology represented by the choice of transmission rates and by the small size has been around for a while, but having it available for the Apple II line (and from Apple) is worth noting.

The memory-expansion card reportedly gives you an extra megabyte of RAM in your IIe. As with the modem, what's interesting is the fact that the product comes from Apple.

Seiko recently sent us a new version of its wrist terminal, the 2001. It's a fun little memo device as well as a pretty good timepiece. You download short messages from an Apple computer to your watch's memory. Then, when the alarm goes off, your watch tells you what you're supposed to be doing instead of making you puzzle out just why this little machine is chirping at you. I thought it was a little odd, however, that an expensive accessory like this would be designed to work with a less-expensive-type computer. I'm also curious about who would get a lot of use out of the terminal. It makes you run over to your computer whenever you want to load up on a new supply of memos. I wonder how convenient that would be after a couple of weeks or months.

Finally, a brief mention of the new Texas Instruments 80286 machine. The Business Pro emphasizes storage capacity in terms of both size and variety. Ours came with a 33-megabyte hard disk (but you can get them up to 72 megabytes), a 60-megabyte tape backup, a high-density 1.2-megabyte floppy-disk drive, and a 360K-byte double-density floppy-disk drive. Something else it seems to emphasize, albeit subtly, is compatibility with IBM software. For example, it comes with its own operating system as well as a version of MS-DOS. This laying down of the welcome mat to an extended family of DOS applications is complemented by a less well-known compatibility with PC-DOS 3.0. Having more and more, instead of less and less, can do wonders for your whole attitude.

Using a variety of operating systems on the same machine results in some mental double-takes from time to time. For example, TI's operating system calls the hard-disk drive E, while MS- and PC-DOS call it drive C. If you put something on the hard disk under one type of operating system, you won't be able to call it up under the other. The files will still show up in the directory—they'll just be out of reach until you boot up again with the appropriate operating system. I didn't find it too confusing, especially since the prompt is different for each mode (\> for TI mode as opposed to > for the others), but I'm not sure whether or not this could get to be a headache in a busy office.

I like the Business Pro keyboard. It has a nice solid feel, a definite tactile-resistance threshold, and an audible click. I also find the middle-finger-bumps on the home row to be helpful. The display doesn't especially appeal to me. It's a color model, and it looks like TI chose gray as the default color for text. In color programs where characters are specifically designed to show up in other colors, the white lettering is quite brilliant. For the normal run of word-processing programs, however, you have the impression of looking at a screen with the brightness level turned way down.

The Business Pro is going to be treated fully as a review subject. I'm looking forward to reading the impression it makes on somebody else.

—*Glenn Hartwig*
Technical Editor, Reviews

S·Y·S·T·E·M R·E·V·I·E·W

The AT&T PC 6300

IBM PC compatibility with a speed advantage

BY BOB TROIANO

The AT&T PC 6300 is an IBM PC-compatible computer featuring a fast 8-MHz 8086-2 processor, graphics capability, and high-resolution color text (see photo 1). The PC 6300, designed jointly by AT&T and Olivetti and manufactured by Olivetti, was introduced about a year ago and is quite similar to Olivetti's model M24. The computer is targeted at large corporate users, professionals, and others who desire a high-quality machine that runs two to three times faster than the IBM PC.

The PC 6300 will run most popular programs, such as Lotus 1-2-3, WordStar, dBASE III, Framework, and Flight Simulator, and it performs admirably in most respects. You can purchase a complete monochrome system with 128K bytes of RAM (random-access read/write memory), two floppy-disk drives, and a nonglare green monitor for less than $3000, while a 10-megabyte hard-disk system costs about $4000. The PC 6300's price includes MS-DOS 2.11 and GW-BASIC. Dealers are giving substantial discounts on this machine. I suggest that you check out a number of dealers' prices before making a purchase.

HARDWARE

The AT&T PC 6300 consists of three separate units: the main system unit, a monitor, and a detached keyboard. The system unit is more compact than most other PC-compatibles, measuring 15 by 15½ by 6½ inches. The keyboard, which is slightly longer than the system unit, measures 17¼ by 7½ by 1.

On the rear of the system unit sits a large, slow-speed fan that keeps the computer cool 24 hours a day. The sound of this fan is quite unobtrusive, even in a quiet room. The trick here is that increasing the size of the fan and reducing the speed still maintains the same cooling capability while lowering the noise level.

The computer's circuitry is located in two areas: a large motherboard mounted on the bottom side of a dividing panel and a smaller bus converter with seven expansion slots mounted on the top side with the dual floppy-disk drives and the power supply.

The main circuitry and DIP (dual in-line package) switches are easily accessible on the motherboard (see figure 1). You remove two screws on the rear panel, then slip off the bottom cover to expose the component side of the board. The bottom cover has vent holes punched on three sides to let air pass over the motherboard's components. Two screws on the rear panel attach the top cover. When removed, it allows access to the seven empty slots.

Most of the ICs (integrated circuits) are not socketed, with the exception of half of the RAM, all PROMs (programmable read-only memories), and a few large ICs. The motherboard has an empty socket for an optional 8087 numeric coprocessor. This computer requires the 8087-2, the 8-MHz version of the chip that costs almost two times more than the slower version. Another large empty socket is on this board, possibly for a special PROM chip that activates some networking or communications capabilities already built into the machine. I had no way to confirm this, however.

On the front panel you will find a green power indicator, access to the two floppy-disk drives (or one floppy and one hard disk), and a reset switch.

The power indicator is nearly useless because it is very faint, but the reset switch is a godsend. When a program crashes and the computer stops, you cannot always revive it with Ctrl-Alt-Del. A reset switch is handy because it lets you reboot the computer without having to turn it off and on, which is not particularly good for computers. [*Editor's note:* AT&T *says that the problem with the dim light-emitting diodes* (LEDs) *has been resolved on later units.*]

KEYBOARD

The keyboard layout is similar to that of the IBM PC (see photo 2), with undersize enter

Bob Troiano is an independent consultant and also does work for General Instrument Corp., Hicksville, New York. He can be contacted at POB 97, Farmingdale, NY 11735.

and shift keys in the same locations. The keys have a distinctive snap to them, similar to the IBM PC's keyboard but not quite as loud, and the touch is not as heavy. The keys are responsive and not at all mushy.

The keyboard is moderately light, weighing about 4 pounds. It is made of impact-type plastic and has two feet that enable it to tilt upward slightly. It has two LEDs, one on the Num Lock and one on the Caps Lock keys. These LEDs reflect the actual status of the machine, as opposed to just toggling on and off when pressed. When the computer is first turned on or reset, the LEDs flash rapidly during the diagnostic checks.

A 5-foot coiled cord attached to the keyboard is connected to the rear of the computer by a DB-type 9-pin connector. On the rear of the keyboard is a connector for a mouse that AT&T has just released.

This keyboard is not compatible with any of the others available for the IBM PC, so if you don't like the way it feels, you're stuck. Maybe some third-party vendors will adapt their keyboards to work with the PC 6300.

VIDEO DISPLAY

The video display is one area where this computer really shines. Two monitors are available for the PC 6300: a green monochrome (see photo 3) and an RGB (red-green-blue) unit.

Built into the computer is the equivalent of a monochrome card and a color-graphics card. The same text font is used for both (an 8- by 16-pixel matrix), whereas the PC has a matrix of 8 by 8 pixels for the color mode and 9 by 14 for a monochrome monitor. All the graphics modes that are available on the IBM PC are available on the PC 6300, and 640- by 400-pixel monochrome high-resolution graphics are available as well. GW-BASIC has been modified to accommodate commands for this special graphics mode.

There is no obvious way at this time to use a color and a monochrome monitor simultaneously as you can with the IBM PC and other compatibles. Some programs that use graphics allow text on one screen and graphics on the other simultaneously. This would be a nice feature, especially in scientific work.

The text font on the PC 6300 is a little different from the IBM PC font. It has 16 colors available in the text mode. With the high quality of the color text, you can easily use this system for word processing without strain on your eyes.

Both the monochrome and color monitors have only two controls hidden either on top or bottom: brightness and contrast. The monitors plug into the back of the computer and come on when you turn on the computer. In fact, the monochrome moni-

(continued)



Photo 1: *The* AT&T PC 6300 *with one floppy-disk drive, monochrome monitor, and keyboard.*

tor doesn't even have a power cord; it gets its DC power from the computer's power supply.

One complaint I have about the color monitor is a slight lack of linearity at the screen's upper left and lower left corners; the text at these positions "pulls" toward the screen's periphery. I inspected several units to see if it was a common problem. It was. Most people would not notice it, but considering that the monitor lists for $945, I find it unacceptable. Good engineering design should eliminate this kind of distortion. AT&T has been notified of the problem.

PROCESSOR AND MEMORY

The PC 6300 is a true 16-bit machine with 16 address lines and 16 data lines. This means that the computer's memory is accessed in words instead of bytes (a word is 2 bytes or 16 bits). The PC 6300 uses an 8086-2 microprocessor with a clock speed of 8 MHz, nearly twice as fast as the IBM PC. This setup could theoretically run more than three times faster than the IBM PC, but in practice it is somewhere between two and three times faster and is program-dependent.

The bus-converter board contains the seven-slot expansion bus. It multiplexes the 16-bit data lines down to 8 bits to maintain compatibility with the existing IBM PC-type cards. The bus converter runs at 4 MHz instead of 4.77 MHz, so clock-speed-dependent IBM-compatible cards might not work. Most cards should run.

Two of the seven slots have an extra connector available for boards that can accept a 16-bit data bus. One problem here is that the second connector is not the same as in the IBM PC AT or any other computer, and I suspect that few manufacturers will market products that use this feature.

Some problems have been reported with standard memory cards other than the AT&T memory-expansion board (which has true 16-bit access by way of the second connector). Check out any memory-expansion boards before you make a purchase.

The motherboard of the dual floppy-disk unit comes with 128K bytes of RAM soldered in and has 18 additional sockets for RAM expansion. The hard-disk unit comes with 256K bytes of RAM soldered into the motherboard. All additional memory requires expansion boards.

The preliminary technical manual that I obtained from AT&T claimed that 256K-byte RAM chips will work in the 0 bank of memory (the ones soldered in) but gave no information on whether the 256K-byte chips will work in bank 1 (the socketed memory). A little experimentation with the DIP-switch settings showed that 256K-byte chips do work in bank 1, allowing 640K bytes of RAM on the motherboard. This was not mentioned in the technical manual. In fact, you won't find any switch settings in the manuals that come with the computer. If you

(continued)



Photo 2: *The AT&T PC 6300 keyboard. Note that the keyboard layout is similar to the IBM PC's except for the Num Lock and Caps Lock keys, which contain LEDs.*



Photo 3: *Text on the AT&T PC 6300 monochrome monitor.*

AT A GLANCE

Name
AT&T PC 6300

Company
AT&T Information Systems
National Sales Center
Suite 300
111 Westwood Place
Brentwood, TN 37027
(800) 247-1212

Size
15 by 15½ by 6½ inches

Components
Processor: 8-MHz 8086
Memory: 128K bytes or 256K bytes, expandable to 640K bytes
Mass storage: Two 360K-byte floppy-disk drives or one floppy-disk drive and one 10-megabyte hard-disk drive
Display: Monochrome or color
Keyboard: IBM PC-type keyboard layout, not plug-compatible
Expansion: Seven IBM PC-compatible slots
I/O Interfaces: Serial, parallel, mouse

Software
MS-DOS 2.11, GW-BASIC

Options

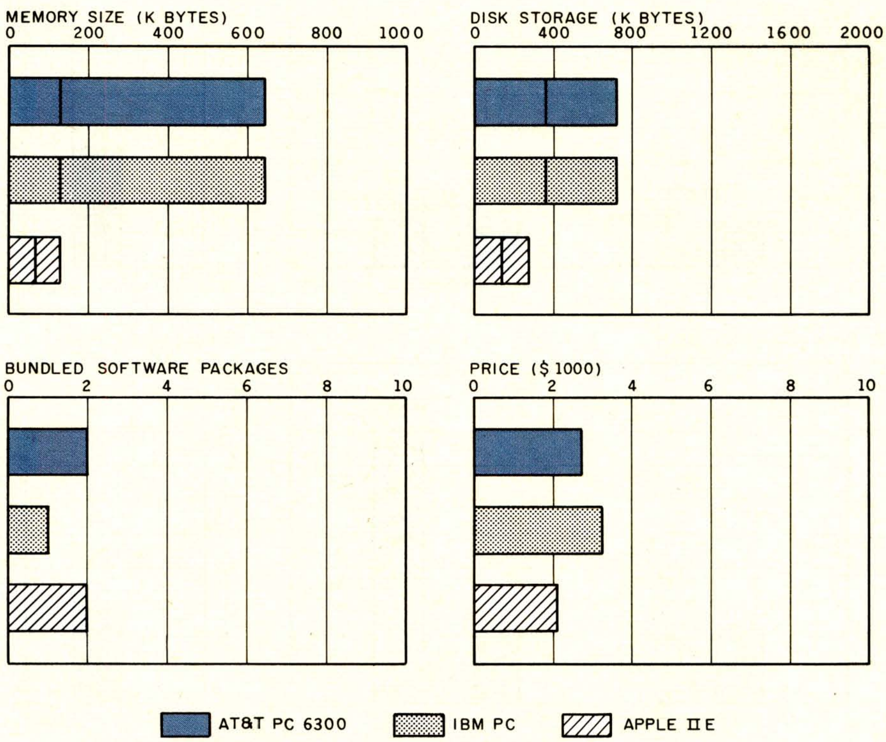
Extended 16-bit memory board (384K bytes)	$595
Color display	$945
Mouse	$150
XENIX operating system	$395
External 10-megabyte hard disk	price n.a.
Optional display adapter	less than $900

Documentation
User's guide, guide to MS-DOS, guide to GW-BASIC

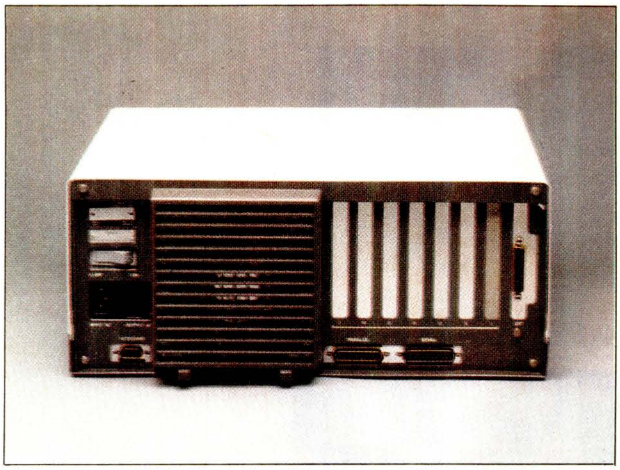
Price

With monochrome monitor, 128K bytes of RAM, two floppy-disk drives, and keyboard	$2745
With color monitor, 128K bytes of RAM, two floppy-disk drives, and keyboard	$3395
With monochrome monitor, 256K bytes of RAM, and 10-megabyte hard disk	$3975

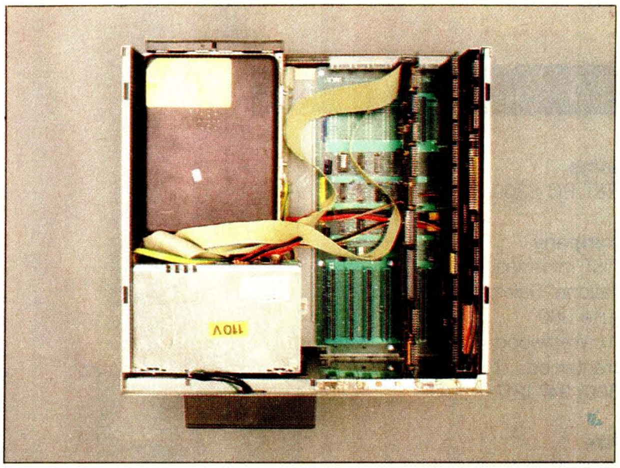




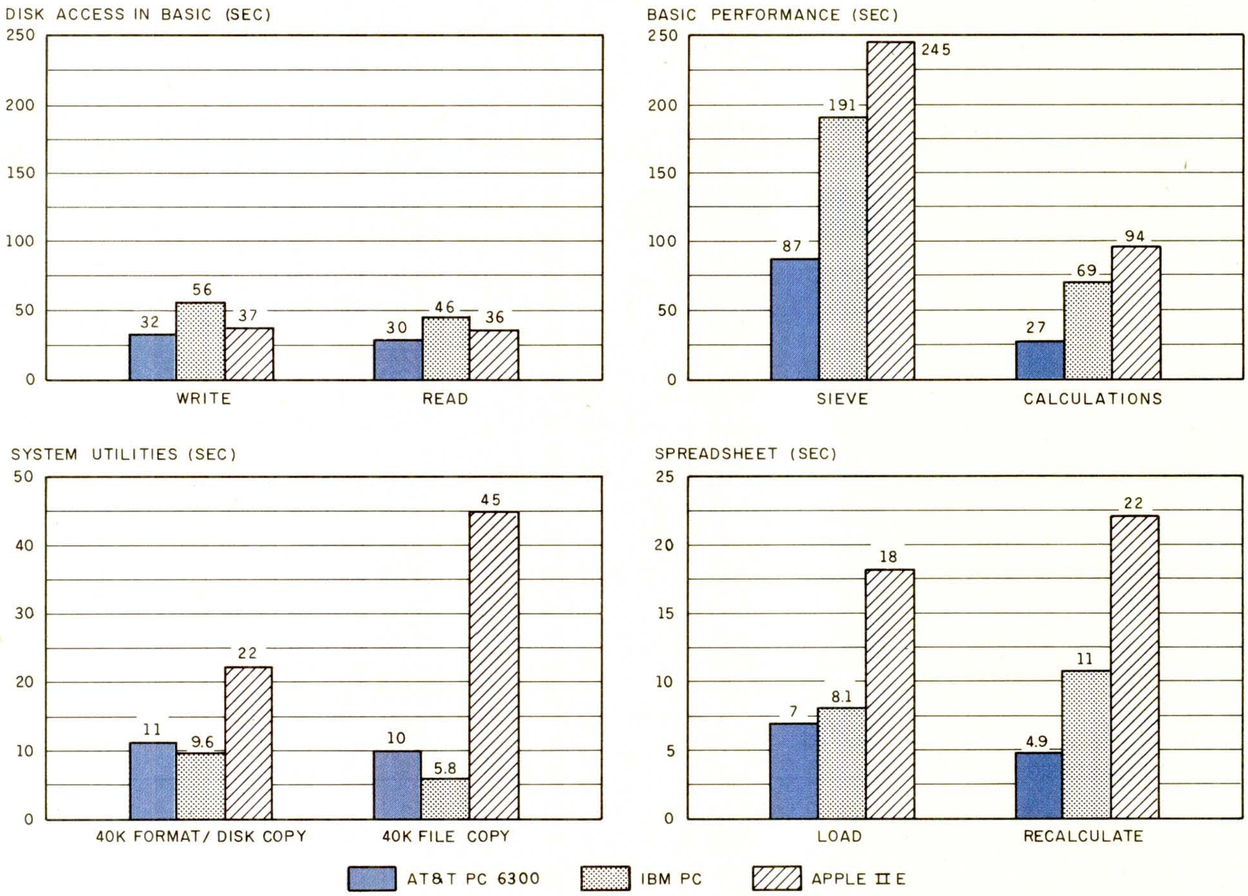
The Memory Size graph shows the standard and optional memory available for the three computers under comparison. The Disk Storage graph shows the capacity of the AT&T PC 6300 in comparison with each of the other computers. The Bundled Software Packages graph shows the number of software packages included with each system. The Price graph shows the list price of each system with two high-capacity floppy-disk drives, a printer port and a serial port, 256K bytes of memory (64K bytes for 8-bit systems), and a monochrome monitor. Price includes the standard operating system and BASIC interpreter for each system.



Rear view of the AT&T PC 6300 showing connectors for the serial port, parallel port, keyboard, and monitor. Note the oversize cooling fan, protective shroud, and connector access slots for the seven expansion boards.



The inside of the AT&T PC 6300 showing disk drive, power supply, and motherboard with expansion connectors.



The graph for Disk Access in BASIC shows how long it takes to write and to read a 64K-byte sequential text file to a blank floppy disk. (For the program listings, see June 1984 BYTE, page 327, and October 1984, page 33.) In the BASIC Performance graph, the Sieve results show how long it takes to run one iteration of the Sieve of Eratosthenes prime-number benchmark. In the same graph, the Calculations column shows how long it takes to do 10,000 multiplication and 10,000 division operations using single-precision numbers. The System Utilities graph shows how long it takes to format and copy a disk (adjusted for 40K bytes of disk data) and to transfer a 40K-byte file using the system utilities. The Spreadsheet graph shows how long it takes to load and recalculate a 25- by 25-cell spreadsheet where each cell equals 1.001 times the cell to its left. The tests for the AT&T PC 6300 used MS-DOS 2.11 and GW-BASIC. The tests for the Apple IIe were done with ProDOS. The IBM PC was tested with PC-DOS 2.0 and BASICA.

want this information, you will have to call AT&T or ask your dealer. The switch settings I used for a 640K-byte motherboard are shown in figure 1. You can use only memory chips with access times of 150 nanoseconds or less for expansion.

The preliminary technical manual mentions a Z8001 coprocessor board for added throughput, but it is not clear how it would operate or if it will be available from AT&T.

POWER SUPPLY AND INTERFACES

The power supply in the PC 6300 is rated at 168 watts (output power) and has additional capability for momentary surges during power-up when you use a hard disk. In the system with dual floppy-disk drives, all seven slots are empty and available for expansion purposes. The floppy-disk controller is built into the motherboard, and the standard display controller is connected to the edge of the bus converter. The system includes as standard an RS-232C serial port, a Centronics parallel port, and a clock/calender with battery backup. A connector for a mouse is provided on the rear of the keyboard. AT&T has recently released a mouse for this machine and claims that it is Microsoft-compatible. I was unable to completely verify this, but the Microsoft programs that I tested worked perfectly.

The PC 6300 is ready to run as shipped, with no hidden costs except the extra memory that you might want to add to the motherboard (if you have the system with dual floppy-disk drives) or a memory-expansion board (if you have the hard-disk 256K-byte system).

AT&T has specifically stated that this is not a game machine and that it does not support games. This is because of the clock-speed differences mentioned earlier. However, I installed a game-port controller card and a joystick and had no trouble using them with Flight Simulator and a few other games. The games seem to run a little faster.

I discovered a slight problem when attempting to run the computer with a serial printer. When the MODE command is used to redirect the computer's output to the serial port, the computer fails to initialize the DTR line and the printer doesn't respond (AT&T has been notified of this problem).

I got around this by writing a short assembly-language program that initializes the DTR line after MODE is run. The IBM PC-DOS MODE command works perfectly on this machine.

SOFTWARE

The PC 6300 comes with MS-DOS 2.11 and GW-BASIC. I recently received an updated disk from AT&T containing release 1.1 of MS-DOS 2.11 and an update to GW-BASIC. A BASICA driver program that loads GW-BASIC is now included and might help some programs that did not run before. Many bugs have been corrected in both DOS and BASIC. This disk should now be available from AT&T.

Another important change is that the hard-disk routines in DOS have been modified to let more than one hard disk be present in the system. The FORMAT command can now format a hard disk larger than 16 megabytes, with or without bad sectors. This means that you could buy a 20-megabyte high-speed hard-disk drive and be running at almost the same speed as the AT.

Two types of diagnostics are included with the PC 6300: ROM-based and disk-based. The ROM diagnostics are performed upon power-up or reset and take only 15 seconds with 640K bytes of memory. If you do a warm boot, the memory test is excluded and the time is shortened to 5 seconds. The disk-based diagnostics are extensive; they include motherboard and video tests and a complex set of memory tests. They also can log errors to a printer.

COMPATIBILITY

Compatibility is probably the key issue that people will want to consider

(continued)

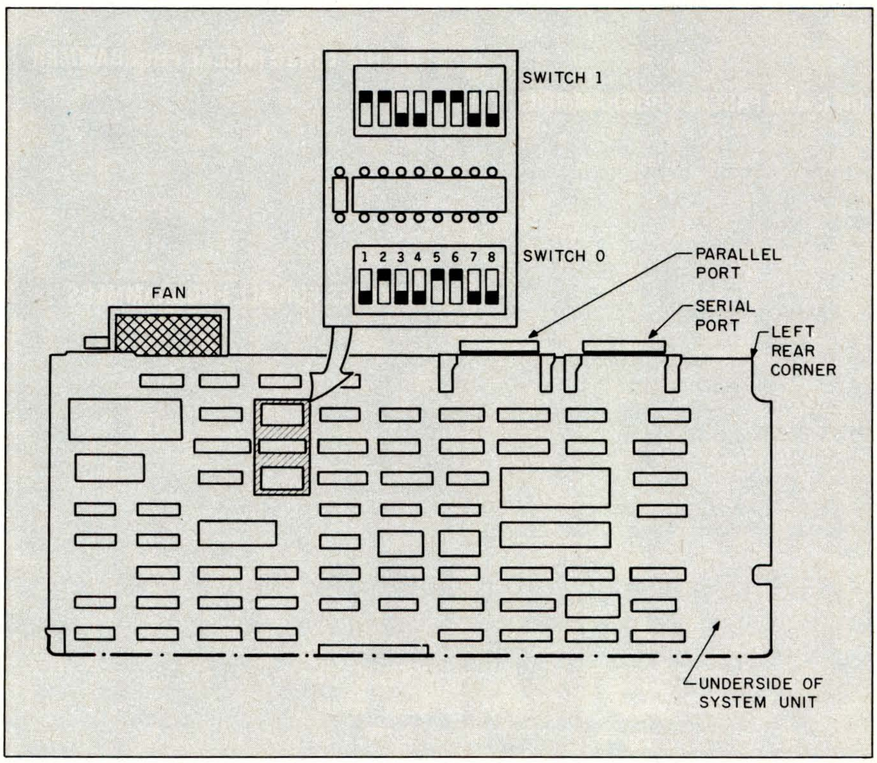


Figure 1: *The bottom right corner of the AT&T PC 6300's motherboard, showing the location of DIP switches and switch settings for 640K bytes of RAM.*

when deciding which computer to buy. The AT&T PC 6300 was designed to be software- and hardware-compatible with the IBM PC. Most of the desirable programs that run on the IBM PC will run on this computer. AT&T has sent dealers a list of about 350 programs that will run on the PC 6300, although a few require patches. The patches are available free of charge from AT&T. Also on the list are several programs that don't run.

Among the programs that have been tested so far and do work are 20 word processors, 12 spreadsheet programs, 15 database programs, and some graphics and communications programs. All Borland products seem to work perfectly with the PC 6300. The performance of Turbo Pascal 3.0 on this machine is breathtaking.

The Example 1 routine of a circuit-design-and-analysis program called PSPICE demonstrates the compatibility between the IBM PC AT and the PC 6300. This program from Microsim Corporation is written in FORTRAN and does mathematical calculations that make extensive use of the numeric coprocessor. Both computers tested were equipped with 640K bytes of RAM and numeric coprocessor chips (the 8087 in the PC 6300 and the 80287 in the PC AT). The test results show a high degree of mathematical processing compatibility.

The calculating time for the transient-analysis routine was 31.7 seconds for the PC AT and 36.5 seconds for the PC 6300. Calculating time for the AC-analysis routine was 31.86 seconds for the PC AT and 37 seconds for the PC 6300. The difference in speed for these tests is only about 15 percent, not bad considering that the PC AT uses a 20-megabyte hard disk and the PC 6300 has only two floppy-disk drives.

The overall time including I/O (input/output) was 137.3 seconds for the PC AT and 213 seconds for the PC 6300. These times reflect the effect of a hard disk on the overall job time.

Compatibility is dynamic in nature, and a program that doesn't run now might run in the future because software manufacturers want their programs to work on as many computers as possible.

Release 1.0 of MS-DOS and GW-BASIC and any other program using the UCSD p-System will not work. Also, programs that are dependent on clock speed, like disk-drive analyzers and certain copy programs, will not run. However, I tried PC-DOS 2.1 and 3.0 and had no difficulty with either.

If you are considering purchasing this computer, you should ask your dealer or AT&T for a copy of the program list.

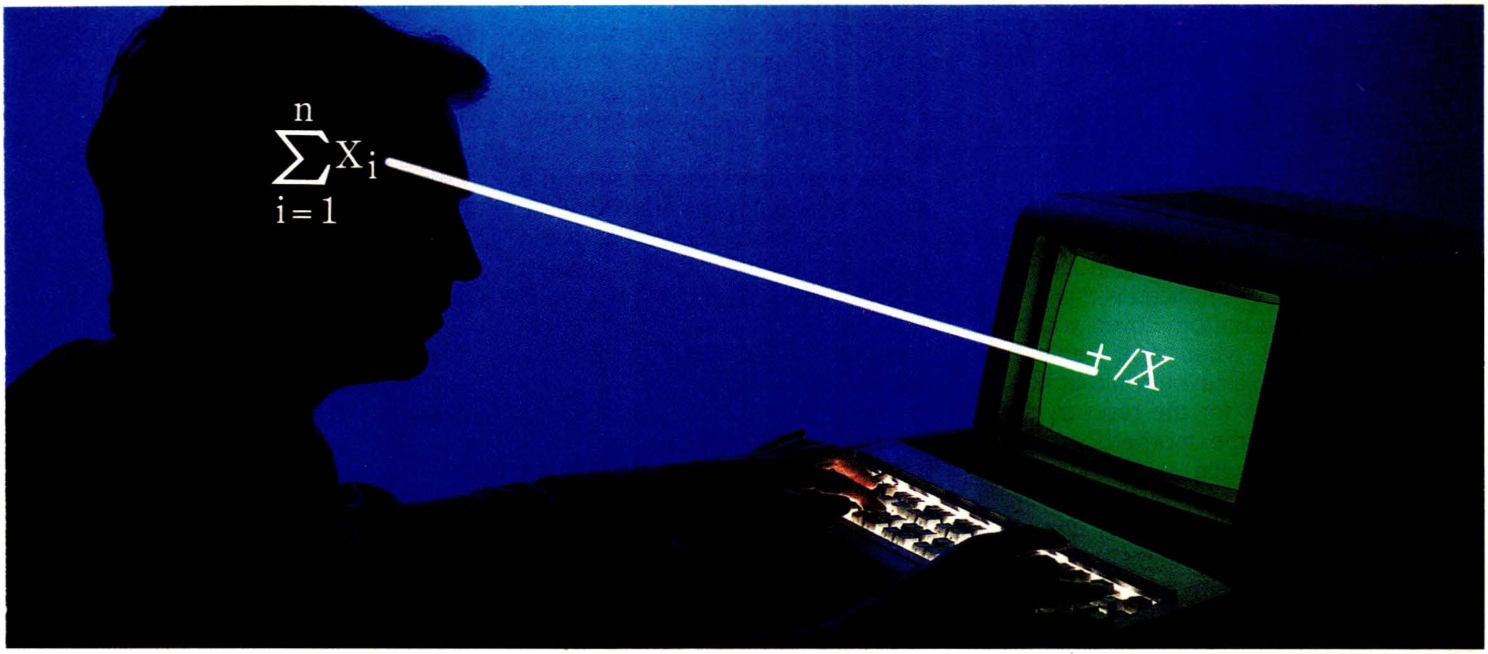
LIMITATIONS

The PC 6300's limitations are few in

(continued)

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- multi-window, full-screen editing
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Plus concise notation for programs like sorting, matrix inversions, string searching, and more. And the complete package price is just $595 with major credit cards accepted.

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APL★PLUS PC System requires 256K and DOS 2.0 or later. A soft character set can be used for computers with IBM compatible graphics board. A character generator ROM or software is included for the IBM PC or selected compatibles.

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Inquiry 340

About 350 IBM PC programs will run, but some require patches.

comparison to its many features, low cost, and terrific color text. Aside from those already mentioned, the only problem I noticed is that, if you remove the bottom cover, you must be careful when you replace it because a plastic button that acts as an extension for the reset switch is located on the motherboard. It is somewhat fragile, and I damaged it when putting the cover back on.

The 8086 processor is quite fast when running programs that do a lot of calculations and screen I/O. However, disk access is not improved significantly by the faster CPU and clock speed. If the program you are going to use does a lot of disk access, you should consider buying the 10-megabyte hard-disk version of this machine.

SPEED

I was curious to know how this 8086 machine fares against the 80286-based IBM PC AT. There is no question that the 80286 is a more powerful chip and that the throughput of the AT with its fast-access hard-disk drive would be better.

Disk Read and Disk Write BASIC benchmarks and the Sieve of Eratosthenes prime-number benchmark compare favorably with times for the IBM PC AT. Disk Read in BASIC takes 30 seconds for the PC 6300 versus 26 seconds for the PC AT. Disk Write in BASIC takes 32 seconds for the PC 6300 versus 24 seconds for the PC AT. The Sieve of Eratosthenes benchmark comes very close to the PC AT time, taking 87 seconds for the PC 6300 and 80 seconds for the IBM PC AT.

These benchmarks demonstrate the raw processing power of the PC 6300, particularly when you consider that in these tests the IBM PC AT is using a hard disk. The "At a Glance" graphs show the results of the BYTE benchmarks for the PC 6300, the IBM PC, and the Apple IIe.

DOCUMENTATION

Three manuals are included with the computer: a user's guide, a programmer's guide to GW-BASIC, and a user's guide for MS-DOS. All are in three-ring binders with slip covers and are fully typeset with illustrations. Each has a table of contents and a good index.

The user's guide has an introduction to the computer's hardware and some brief instructions on starting up the first time. It also has a nice glossary of computer terms. The disk diagnostic operating instructions are included in this manual. I would have liked a little more detail on what the diagnostics were doing, but for most users the information included will be sufficient.

Both the GW-BASIC and the MS-DOS manuals have a tutorial section and a reference section. Each command has at least one example showing how it is used. For some reason, the instructions for DEBUG and LINK usage were not mentioned in any of the manuals. I later found out that these programs are described in the system programmer's manual.

I obtained a final copy of the system programmer's manual and a preliminary copy of the technical reference manual. I was also assured by AT&T personnel that a complete service manual with advanced diagnostics was in preparation. The system programmer's manual contains information on DEBUG, LINK, memory maps, file allocation tables, system calls, and drivers, and a complete commented ROM BIOS printout.

The technical reference manual is equally good. It describes each circuit subsection in detail, gives a summary of how the computer works overall, and has all DIP-switch information with the exception of how to set up the 256K-byte RAM chips on the motherboard. All that was missing was a complete set of schematics.

The manuals are expected to sell for under $65, except the service manual, which will probably be about $125. It was a wise move on AT&T's part to make this information available to users and programmers, especially since the computer's enhanced graphics and other special features can't be fully used without this kind of information. The part numbers for the above manuals are shown in table 1.

Table 1: *Part numbers and estimated prices for optional* PC 6300 *manuals.*

Manual	Part number	Estimated price
System programmer's manual (available now)	403319015	$65
Technical reference manual (available soon)	403319023	$65
Service manual (available soon)	403319031	$125

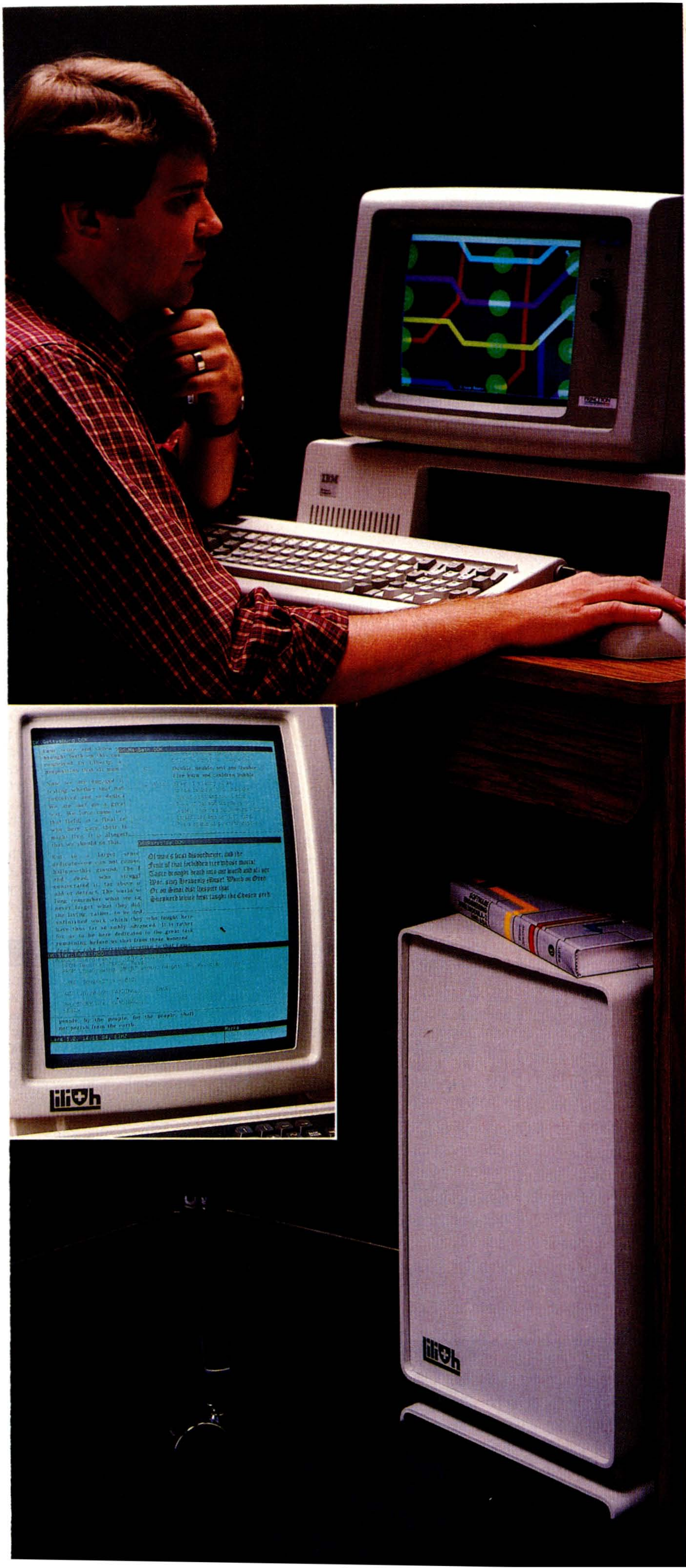
SUMMARY

The PC 6300 is a fine computer with relatively minor problems. AT&T's reputation for product support is a guarantee that you won't end up with an orphan. The PC 6300 runs most of the best IBM PC software around and runs it two to three times faster.

The color monitor and text screen are considerably better than those of the standard IBM PC and are comparable to a PC with an Enhanced Graphics Adapter board. I would recommend this machine to anyone contemplating the purchase of a PC-compatible computer, including business users, programmers, and scientists. ■

ACKNOWLEDGMENTS

I would like to thank Tony Nuzzi of Falcon Computers, Hicksville, New York, and John Logowski of Computer Factory, Garden City, New York, for their assistance in the preparation of this article.



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Complete hard disk kit $395

Comes complete with virtually the identical controller that's in the IBM®XT, and Xerox® warranties the hard disk for one year

Guaranteed 100 percent IBM PC compatible

How can we offer this fantastic price? Simple. We buy in such volume that even the most avaricious hard disk businessmen understand they have to give us the best price possible. We could pocket the difference, but we don't.

Instead, we put the extra profit into our testing facilities. That's why Xerox guarantees our $395 10 megabyte hard disk for one year.

Xerox knows, as our customers know, that we have an extensive testing program. Here is what we contribute toward giving you the maximum hard disk performance.

Best Drives Available

First, we buy the best drives available. Sounds trite, doesn't it? I mean, a drive's a drive—right? Hardly. You should see some of the junk we get in our labs. Some have such high failure rates that we even questioned our own $10,000 hard disk tester. But when we tested other manufacturers' drives we were assured that our equipment was fine, which just confirmed that the bad hard disks were not only bad—they were real bad.

But that's just the weeding out process. We then take each drive that we've put through our tester and test it again with the controller you've requested. We call this a "tested pair."

DOS Doesn't Do It

In case you're thinking that all this is an unnecessary duplication of what DOS does for you, let me explain the disk facts of life.

If DOS did what you may think it is supposed to do when you format the disk, DOS would map around these bad areas. Unfortunately, DOS doesn't do this.

DOS 2.0 and 2.1 can't enter the bad tracks. DOS 3.0 can, but only on the IBM AT. Unfortunately, as the press has so well documentated, the AT's hard disk develops bad tracks later on.

We do what DOS can't

We believe the problem is so bad, we use a software program that performs a powerful test of your disk drive on all of the IBM or IBM compatible computers—PCs, XTs, and ATs. Our format takes hours to analyze the disk. But when we finish, you know that the bad tracks are really mapped out so you won't write good data that will disappear into a black hole. We even send you a printed statement of our test results.

Our software allows you to type in the bad track locations from the list supplied by the manufacturers, so you'll never write good data to them—even if DOS didn't identify them as bad. The software even lets you save the location of these bad sections to a file, so that you can reformat your disk without spending hours retesting.

We even include a program that will give you continuous comments on the status of your hard disk. No more waiting for that catastrophic failure.

Average Access Time

As you might suspect, some hard disks are faster than others in their ability to move from one track of data to another. The time it takes the hard disk to move one-half way between the beginning of the disk to the end is called the "average access time."

The first generation of 10 megabyte hard disks had average access times of 80-85 milliseconds (msec). But computer users love speed, and guess what—the average access time for the new 20 megabyte hard disk in the IBM AT is only 40 msec. (We sell an AT equivalent with only 30 msec access time!)

There are some legitimate reasons for the shorter access time. It's particularly helpful when there are multiple users on the same hard disk. It's also important when running a compiler. But remember, before you get too wrapped up in the access speed, there's always that ST 506 interface which won't let data transfer from the hard disk to the computer any faster than 5 megabits/second. We've bypassed that choke hole, too. If you want the functional equivalent of a Ferrari with a turbocharger, order our 10 Mbit per second 100 megabyte hard disk with 18 mse of average access speed.

Compatibility

To be sure that your hard disk 100 percent compatible with th IBM XT you don't need to bu the same hard disk that's in th XT. You can't even be sure wh brand hard disk it is becau IBM, like Express Systems, go into the marketplace and bu hard disks from several vendor However, they buy their X hard disk controller from on one vendor—the same one w do.

You can buy the IBM XT co troller from IBM for $495 or yo can buy from us, the function equivalent, manufactured by th same company that makes it f IBM for only $195. Is it the e actly identical IBM XT contro ler? No, it's better. First, it tak less power, and secondly, it ca control from 5 to 32 meg bytes—the IBM controller ca work with only 10 megabytes. is 100 percent IBM XT compa ble, and 100 percent is 100 pe cent. If you want to save a slo we carry a version that lets yo operate two hard disks and tw floppy disk drives.

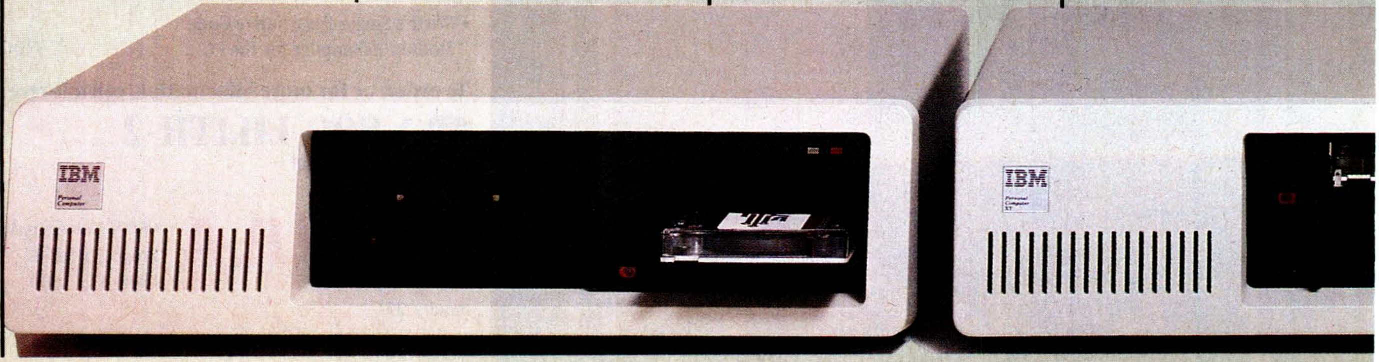
More than 32 Megabytes

You can operate with more tha 32 megabytes (the limit of DO through the use of "device dri ers." Express Systems can supp you with device drivers for o hard disks for over 32 megabyt formatted. But, if you don't ha individual files, or databases th are large, you might want to co sider one of our controllers th can divide our 65 megabyt (formatted) hard disk into tw equal volumes of 32 megabyt each.

Reliability

We offer you a choice betwe iron oxide and plated media the stuff that covers the ha disk and gives it its magne properties. Iron oxide is,—we it's rust. If you inadvertent joust your disk, you may cau the low flying head to dig o some iron oxide. A little ru flake can ruin your whole da Plated media is more resistant damage, and if it happens, le data is lost.

We offer both types of ha disks. The iron oxide is old



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echnology, and quite frankly, manufacturers understand it better. Their better understanding, combined with some of the special head locking mechanisms, gives us peace of mind when we sell you one.

Power

Hard disks consume power. Our small, half-high hard disks consume so little power that you can use them with your existing IBM PC power supply. If you plan to use lots of slots, you'll want to increase your power supply to be safe. We offer the same amount of power for your PC that comes in the XT.

Our Customers

Some folks just never feel comfortable buying mail order. They forget that Sears began as a mail order house or that IBM is now into mail order. But, if it helps, here is a *partial* list of customers who have felt comfortable to buy from us.

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U.S. Army	MIT
AT&T (Bell Labs)	RCA
Bausch & Lomb	Lockheed
Xerox	Sperry

Easy to Install

If you're like most of us, raised on the boob tube rather than the Great Books, you'd rather see the movie than read the book. Well, now you can choose to read our installation manual or for only $9.95 more, you can get a VHS or Beta video cassette showing the simple steps for installation.



Warranty

We offer you a one year warranty on our hard disks—the same as IBM on the AT and 90 days on the tape drives. (It's all the manufacturer gives us.) If anything goes wrong with your tape or disk drive or hard disk, send it back in the box it came in. However, we have found that we can usually solve the problem over the phone. So call first for a return authorization number because we can't accept any returns without it.











Complete Hard Disk Kits

Formatted MB	Height	Plated Media	Average Access	Transfer Rate	PC or PC/XT	AT
10	½	no	85 msec	5 Mbits/s	$ 395	$ N/A
10	½	yes	85 msec	5 Mbits/s	$ 495	$ N/A
21	½	yes	85 msec	5 Mbits/s	$ 795	$ 595
21	Full	no	30 msec	5 Mbits/s	$ 1,535	$ 1,340
32	½	yes	85 msec	5 Mbits/s	$ 995	$ 795
32	Full	no	30 msec	5 Mbits/s	$ 1,775	$ 1,575
65	Full	no	30 msec	5 Mbits/s	$ 2,295	$ 2,070
100	Full	yes	18 msec	10 Mbits/s	$ 4,995	$ 4,995
Removable Hard Disk						
10	½	no	90 msec	5 Mbits/s	$ 1,095	N/A

Tape Systems and Subsystems

Formatted Storage Capacity	Height	Data Transfer Rate (k/sec)	PC or PC/XT	AT
60 Mbytes	½	88	$ 995	$ 995
60 Mbytes Subsystem		88	$ 1,295	$ 1,295
21 Mbytes (unformatted) Start/stop Subsystem		24	$ 595	$ 595
26 Mbytes Floppy Tape® Subsystem		31	$ 749	$ 749

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All of our hard disk and tape controllers are available separately: Please call for prices.

Subsystem Chassis

Any of our disk or tape units are available in an external subsystem for an additional $250.00. You can mix & match any of our ½ high hard disks or tape drives together or add any single full height hard disk.

Tape Cartridges

Express Certified 555 foot 310 Hci ¼-inch Data Cartridge — $35.00

Power Supply

130 Watt Power supply — $75.00*

150 Watt Power supply — $125.00

*with the purchase of any drive

Comes complete

All Express Systems products come complete with the appropriate software, tape and/or hard disk controllers, and cables where required. Hard disks are formatted and tested with the PC DOS of your choice. All drive sizes are formatted capacities.

If your application requires a stacking kit, power splitter cables, daisy chain cable, or some other variation, we'll supply these items at a nominal charge. We even ship our hard disks with Command Assist™ an on-line DOS-like manual to give you help with your DOS commands.

More questions?

Because we spend so much attention on the front end with ensuring that our disks will arrive in working order, we have a customer service department that, unlike many of our competitors, has little to do. When you need us, you won't get a constant busy signal.

Call our friendly, knowledgable customer service staff to get answers to your questions—before or after the sale. Our people, who know the PC, can talk you through the sticky parts, and they'll respond to you quickly. Just call us.

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Pick up the telephone and call 1-800-341-7549, to order. We accept Master Card, VISA, American Express and Diners Club. Or send a cashier's check or money order (We'll take a check, but you'll have to wait for it to clear) and tell us if you want one of our recommended configurations or you want to mix and match yourself. Corporations with a DUNS number may send purchase orders for quantities over five.

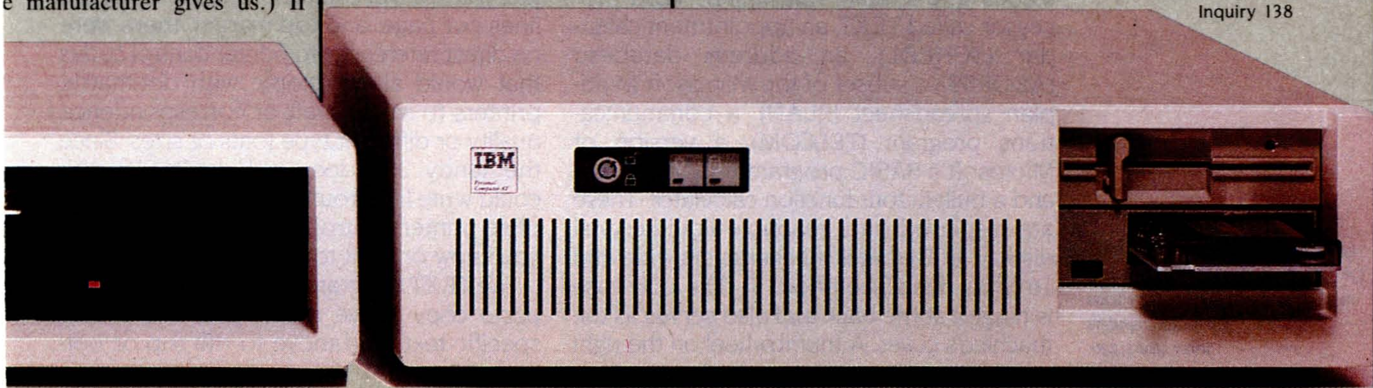
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Inquiry 138



S·Y·S·T·E·M R·E·V·I·E·W

The Tandy 200 *and the* NEC PC-8401A

Real portability at a price

BY HARRY KRAUSE

The Tandy 200 (see photo 1) and the NEC PC-8401A (see photo 2) are both second-generation offerings, substantially improved over their predecessors, the Tandy Model 100 and the NEC 8201A. Neither, however, seems designed to replace a full-featured desktop or transportable microcomputer; despite their refinements, these laptops present serious users with significant shortcomings. And, in relation to the low prices for which you can now buy an Apple IIc or even an IBM PC-compatible 16-bit machine, these laptops—at approximately $1000 each—are expensive.

The Tandy 200 and the NEC 8401A are about the same size (12 by 8½ by 2½ inches) and weight (4 to 5 pounds), use a Z80-equivalent central processing unit (CPU), work off batteries or AC power, and have a built-in 300-bps (bits per second) modem. Both have a decent keyboard with full-size keys. Both are "closed" systems; you cannot easily open them to upgrade or add hardware functions. Lots of extra-cost (and pricey) exterior accessories are available for both. Aside from these similarities, the machines move along quite different paths.

THE TANDY 200

The Tandy 200 has fewer potential software capabilities than the NEC 8401A but is easier and more fun to use. Software burned into its read-only memory (ROM) includes a functional but limited word processor called TEXT, an appointment calendar (SCHEDL), an address database (ADDRSS), a subset of the Microsoft Multiplan spreadsheet (PLAN), a communications program (TELCOM), a version of Microsoft's BASIC programming language, and a built-in four-function calculator. These are displayed on a readable liquid-crystal display (LCD) that is 40 characters wide and 16 lines deep (see photo 3). The LCD case is hinged at the back and also serves as the machine's cover. A thumbwheel on the right of the machine controls the contrast.

You access the word processor and other applications through the machine's opening menu, which lists the available programs. To select a program, you simply move the cursor over the name of the program and tap the Enter key.

There are 72 keys on the QWERTY keyboard (see photo 4), including cursor controls and function keys, and I had no difficulties entering text or data. The keyboard's feel isn't much different than that of most other microcomputers, and the alphanumeric keys are in the usual places. The function keys are along the top of the keyboard, and the cursor controls are at the upper right-hand side.

Once selected, the TEXT word-processing program begins by asking you the name of the file you want to edit (or create). The Tandy 200 uses a six-character file-naming convention and creates its own extension. If you entered a letter named GEORGE, upon retrieval it would appear on the opening menu as GEORGE.DO, the .DO indicating the file is a text file and not a program.

As you enter text and reach the end of the 40 columns available on the screen, your words wrap to the next line. A printed file can be 132 columns wide. Because of the screen-width limitations, however, it is impossible to visualize how paragraphs and sentences will break in the final printed document. Also, while the PRINT command lets you control printout width, left margin, lines per page, and top margin, there were no direct references to printer control codes that would allow people with dot-matrix printers to select draft or correspondence quality or different type fonts or sizes. Since the Tandy 200 does include BASIC, you could write little routines to gain more complete printer control, but this assumes that you know or want to learn how to program.

The TEXT program allows you to cut and paste copy, move to the next word, find specific text, and move to the top or bot-

Harry Krause (10214 Forest Lake Dr., Great Falls, VA 22066) is a marketing consultant whose clients suddenly got microcomputers three years ago.

tom of a file. Word processing is viable on the Tandy 200, but not if you have a high level of expectation. The machine's predecessor, the Tandy 100, was very popular with itinerant journalists taking notes while on assignment. The Tandy 200 should be equally popular with them.

The SCHEDL, ADDRSS, and TELCOM programs use files created with the word processor and work similarly. In SCHEDL, for example, you create a text file called NOTE.DO. In the file, you'd enter information in the following format:

7/14/85, Call Fred about overdue check
7/23/85, File property tax records
12/31/85, Quit work early

Search functions call up entries with the same date or the same keywords.

The ADDRSS program uses a variation of the NOTE.DO format, with names listed first, followed by telephone numbers and addresses:

Joe Tandy: 703/936-3211: 123 Main St., Alexandria, VA 22314

You can also access these address files through the TELCOM program in conjunction with the Model 200's built-in 300-bps modem (or an external 1200-bps modem). TELCOM also lets you set communications parameters and auto-dial phone numbers directly from the keyboard. The program makes good use of the function keys in interactive mode to auto-dial numbers, display communications parameters, enter the terminal mode, and return you to the main menu. In terminal mode, you can hit function keys for printing out transmitted data, sending special break signals, and saving data into text files.

Other than the built-in BASIC, the remaining software of interest is a variation of Multiplan. This spreadsheet program holds data in up to 63 columns and 99 rows (6237 cells), size enough for a substantial amount of data. It would not be fair to measure this implementation of Multiplan against the versions that run on IBM PCs and compatibles. The subset includes more than three dozen functions and more than a

(continued)



Photo 1: *The Tandy 200.*



Photo 2: *The* NEC PC-8401A.

dozen commands from the Multiplan repertoire. Tandy commissioned a special instruction manual for its version of the spreadsheet; it is easier to read and follow than the manuals usually packed with this kind of software.

Tandy's ROM implementation of Microsoft BASIC is quite impressive and complete. People with IBM PC-compatibles will recognize virtually all the commands and syntax on the Tandy 200 because they are a subset of the ones they've been using. In fact, to check compatibility, I entered the well-known Sieve of Eratosthenes program directly from a listing on my PC, changing only a comma into a semicolon on the final line: PRINT J$; TIME$.

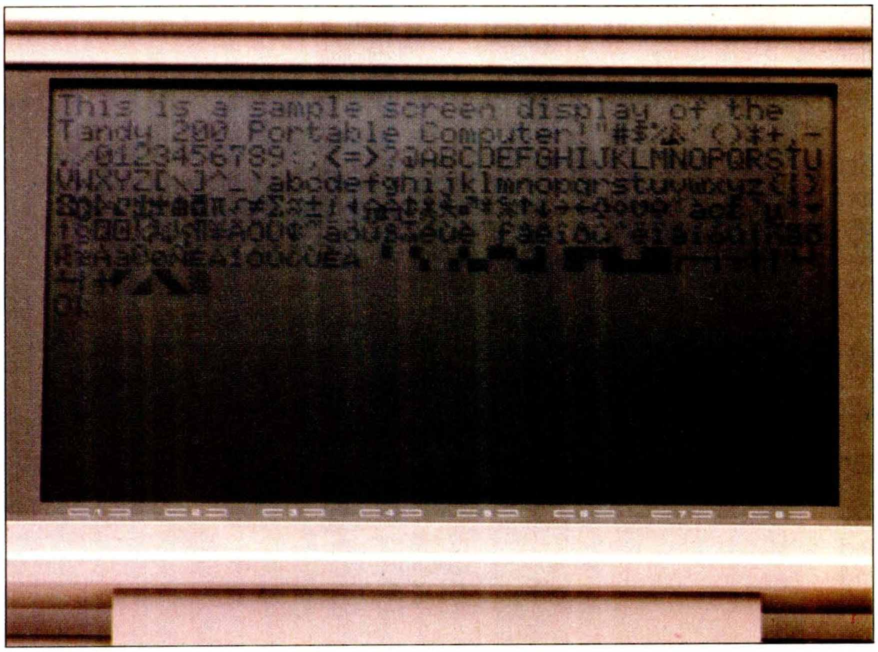


Photo 3: *The Tandy 200's LCD displays 16 lines of 40 characters each.*



Photo 4: *The Tandy 200's 72-key keyboard.*

On the Tandy 200, the program found 15 primes and ran in 190 seconds. The same program on an IBM PC takes only about 30 seconds less.

Storage capacity for BASIC programs and other files is somewhat limited. The Tandy 200 comes standard with 24K bytes of RAM (random-access read/write memory), 19.5K bytes of which is accessible for programs or files. The machine can hold up to 72K bytes of RAM in "banks" that are switchable by tapping on the F1 or Tab key. Each bank is an island with room for 47 filenames. Programs will crash if they require more memory than is available on a single bank. All the ROM-based programs except SCHEDL are accessible from any of the RAM banks. The 24K-byte RAM banks are installed by the dealer and list for $249.95, or slightly more than $10 for each 1K byte of RAM—a fairly steep price.

If you have files that will not fit in internal RAM, you'll need to consider an exterior storage device, such as Tandy's data cassette recorder ($59.95) or disk drive/CRT (cathode-ray tube) display unit ($799). The latter includes a 5¼-inch floppy-disk drive and an adapter that you can attach to a television set or video monitor. The Tandy disk drive/display adapter unit seems overpriced, especially since its drive is only single-sided and formats floppy disks holding just 184K bytes.

Tandy says it will soon have a substantial library of software for the Model 200 available on cassette tape or in special ROM cartridges that plug into the bottom of the machine. In its instruction manual, the company points out that most of the software available for the Model 100 will not work on the 200.

I should briefly mention some of the machine's other features. There's a built-in calendar/clock addressable from BASIC, an automatic power shutdown, the four-function calculator that can be used in the midst of other programs, some modest graphics available from BASIC (and presumably from programs Tandy will release), an

AC adapter, free introductory time on a couple of well-known databases, cables to connect the built-in modem and the phone jack, a printer cable, and a canvas carrying bag with shoulder strap. Actually, the bag may be an extra-cost accessory, but I have seen it advertised as a giveaway with the purchase of a Model 200. Tandy also claims its dealers can adapt the Model 200 to run on rechargeable nicad batteries. I got 10 hours of operation out of a fresh set of AA alkalines; according to Tandy's manual, I should have gotten 14.

THE NEC PC-8401A

The NEC PC-8401A is substantially more capable than the Tandy 200, with a subset of the 8-bit CP/M 2.2 operating system built in. The NEC's LCD (see photo 5) is 80 characters wide by 16 lines deep, a standard that perhaps exceeds the capabilities of the video hardware. The display, plain and simple, has so little contrast it is next to impossible to read in almost any kind of reflected light.

At first, I thought I had received a defective evaluation unit, so I looked over a few others at a dealer's. They were just as bad. The display has a contrast control and, like the Tandy 200, is hinged to serve as the machine's cover. All I had to show for my efforts was eyestrain. Readability is not helped by characters that barely fit in the allocated space; descenders on one line crash into ascenders on the next line. [*Editor's note: As this review was being edited, NEC announced a new LCD screen for the 8401A that is 9½ inches wide by 3 inches high, approximately 40 percent larger than the earlier 7¾-inch by 2½-inch LCD. NEC claims the larger LCD allows for bigger dot size, larger characters, and a "substantial improvement in legibility." Other features of the 8401A remain the same.*]

Two alternate character sets are available: Greek and graphics symbols. The Greek characters are no more readable than the alphanumerics.

The NEC keyboard has 68 keys (see photo 6), including 4 cursor control keys and 5 function keys that can perform more than one task. The keys are full size and work smoothly but make a loud click-clack sound when you're typing rapidly.

NEC is generous with built-in memory, with 64K bytes of RAM and 96K bytes of ROM. If you need more RAM, you can buy a 32K-byte cartridge for $199, a sum that seems substantial when you consider that 150-nanosecond 64K-byte RAM chips are available for $2 each. Still, NEC's memory modules are cheaper than Tandy's.

The back of the machine is filled with ports: a DC input (the AC adapter is provided); a line jack and phone jack for connecting the built-in modem, an external modem, or a phone; an RS-232C port for a serial

(continued)

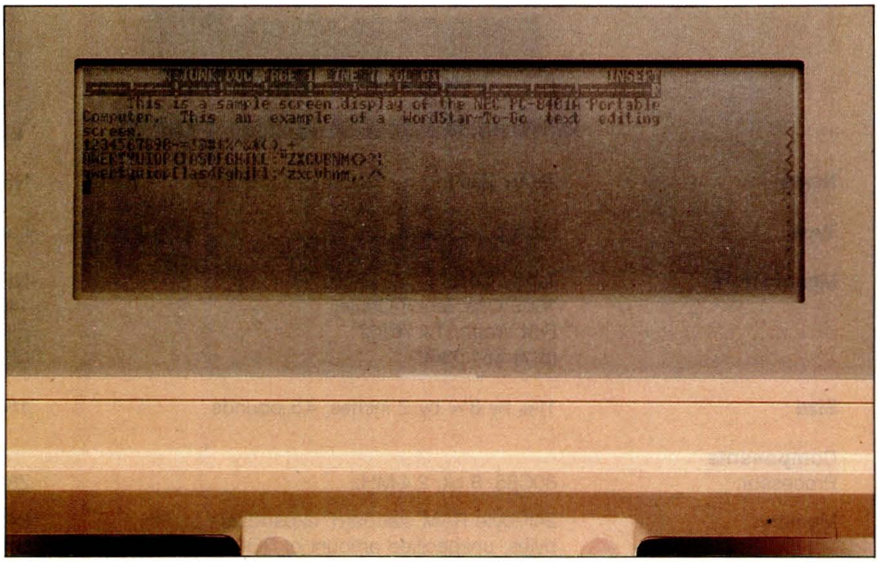
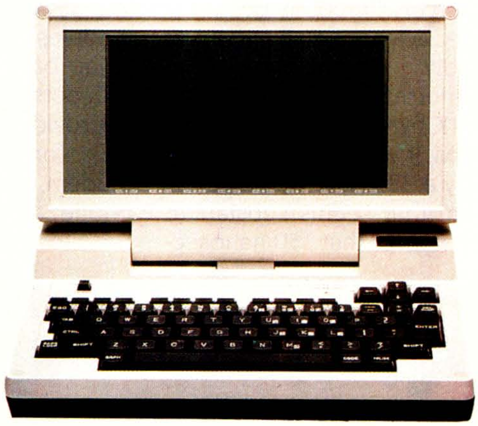


Photo 5: *The* NEC PC-8401A *features an* 80-*character by* 16-*line* LCD *that is often difficult to read.*

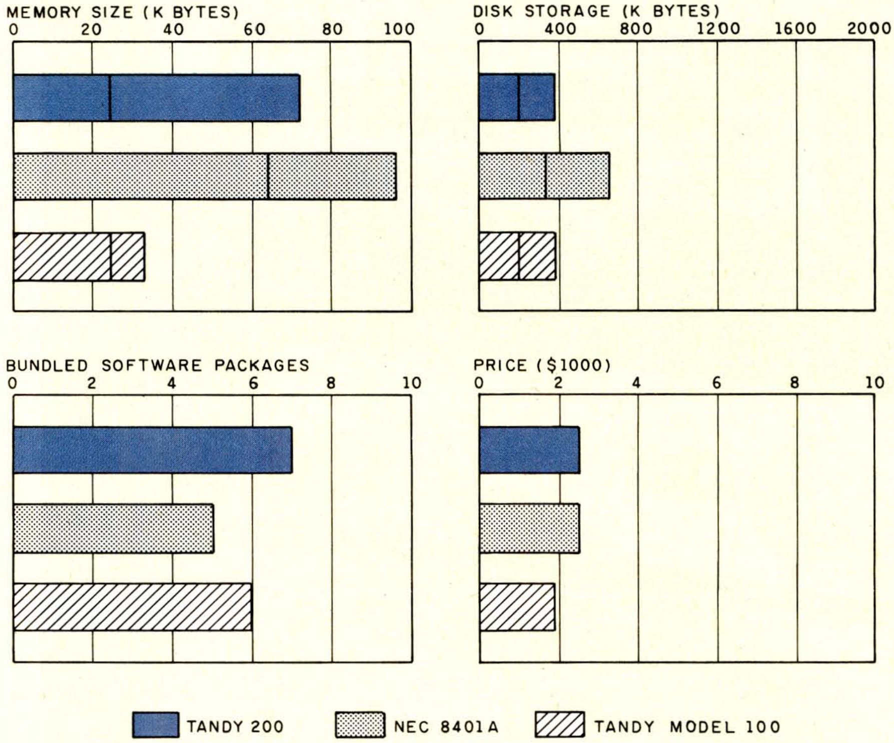


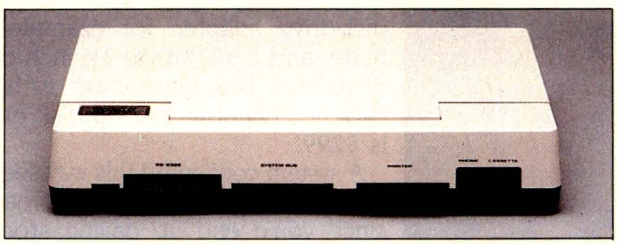
Photo 6: *The* NEC PC-8401A 68-*key keyboard.*

AT A GLANCE

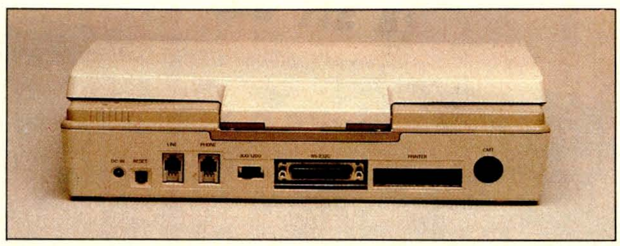
		
Name	Tandy 200	NEC PC-8401A
Type	Laptop computer	Laptop computer
Manufacturer	Tandy Corp. 1500 One Tandy Center Fort Worth, TX 76102 (817) 654-9369	NEC Home Electronics Inc. 1401 Estes Ave. Elk Grove, IL 60007 (312) 228-5900
Size	11⅝ by 8¼ by 2 inches, 4.5 pounds	11¾ by 8½ by 2¼ inches, 4.5 pounds
Components		
Processor:	80C85, 8-bit, 2.4-MHz	Z80-compatible μPD70008C, 3.9936-MHz
Memory:	24K-byte RAM standard, expandable to 74K bytes; unspecified amount of ROM holding software programs	64K-byte RAM standard, expandable to 96K bytes; 96K bytes of ROM holding software programs
Display:	40-character by 16-line LCD; black letters on gray background	80-character by 16-line LCD; black letters on gray background
Keyboard:	72 keys (8 function keys), QWERTY	68 keys (5 function keys), QWERTY
Modem:	Built-in, 300-bps	Built-in, 300-bps
Power:	Battery or AC	Battery or AC
Expansion:	Memory can be added internally by authorized dealers; no slots	Memory can be added externally with a plug-in cartridge
Interfaces:	RS-232C, cassette, parallel printer (Centronics), modem, bar-code reader, external bus	RS-232C, cassette, parallel printer (Centronics), modem/phone/line jacks, external bus
Software	Proprietary operating system, Microsoft BASIC, Multiplan, word processor, appointment calendar, database, and telecommunications, all in ROM	CP/M 2.2 operating system, MicroPro WordStar-To-Go, Calc-To-Go, Personal Filer database, and telecommunications, all in ROM
Options	Disk drive with display adapter, \$799; cassette recorder, \$59.95; 24K-byte RAM, installed, \$249.95	Display/disk-drive adapter, \$249; 3½-inch disk drive, \$599; second drive, \$299; 32K-byte RAM cartridge, \$199; 1200-bps modem cartridge, \$299
Documentation	Owner's manual, Multiplan manual, TELCOM manual, BASIC manual	User's manual, quick guide, Calc-To-Go manual, WordStar-To-Go manual, TELCOM and Personal Filer manual
Price	\$999	\$999

The Memory Size graph shows the standard and optional memory available for the three computers under comparison. The Disk Storage graph shows the highest capacity of one and two floppy-disk drives for each system. The Bundled Software Packages graph shows the number of software packages included with each system. The Price graph shows the list price of a system with two high-capacity floppy-disk drives, a monochrome monitor, a printer port and a serial port, 64K bytes of memory, and the standard operating system and BASIC interpreter for each system. Note that the Tandy Model 100 has a maximum of 32K bytes of RAM.

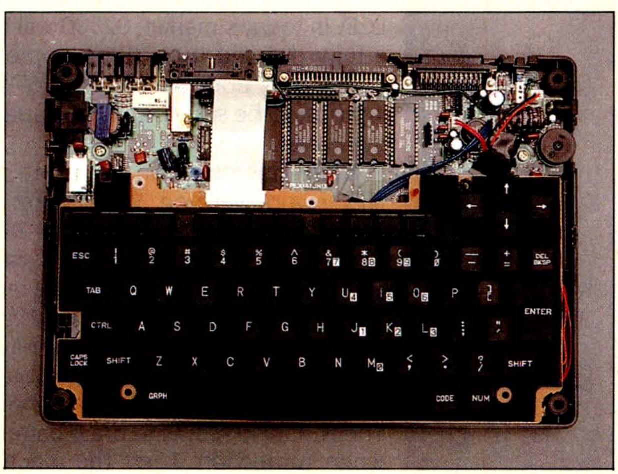




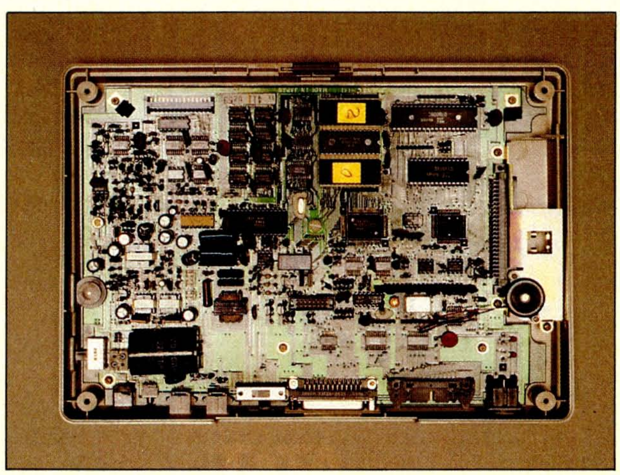
The back of the Tandy 200.



The back of the NEC PC-8401A.



The Tandy 200's internal circuitry.



The NEC PC-8401A's internal circuitry.

If you want to add peripherals to the 8401A, you will most likely have to stick with NEC offerings.

printer or direct connection to another computer; a parallel printer port; and a data-recorder interface. On the side, there's a system slot for connecting a RAM cartridge, a CRT/disk-drive adapter, or NEC's proprietary 1200-bps modem.

Because the machine is a closed system, users who want to add flexibility with peripherals will most likely have to stick with NEC offerings. The list prices for many of these seem unnecessarily high. The CRT display/disk-drive adapter, for example, is $249, and a 327K-byte 3½-inch disk drive (in a box big enough to hold two) is $599. The second disk drive is $299.

A system configured this way seems like less than the sum of its parts, since you'd end up paying around $2300 for the machine, the display/disk-drive adapter, two drives, and an inexpensive monitor to replace the LCD. In today's market, $2300 will buy a fully dressed IBM PC or Apple IIc or the new portable Kaypro 16—not laptops, to be sure, but more capable machines.

While operating on batteries, the NEC is a power hog. When I first got the machine, I popped in four fresh C batteries of the "el cheapo" variety. They were eaten up in a little more than two hours, or so said an indicator light on the machine's control panel. Next, I tried a set of name-brand alkalines; they lasted about six hours. The NEC also seems to drain batteries when turned off. I left the machine alone for a week with a new set of nonalkaline batteries installed; when I came back to it, I got the indicator light after only 45 minutes of opera-

tion. In its instruction manual, NEC mentions using rechargeable nicad batteries but states it makes neither nicads nor chargers. I'd be leery about installing nicads in a $1000 piece of hardware without a specific recommendation from the manufacturer about approved vendors.

In a somewhat strange way to conserve battery power, NEC builds in what it calls a "sleep" mode. You can put the machine to sleep (without actually shutting it off) and then have it wake itself up at a predetermined time. Why you would want to do this instead of just turning off the computer escapes me, and none of the bundled software mentions the sleep capability. If it works with TELCOM, the ROM telecommunications program, I assume you could have the unit automatically dial a data bank at off-peak hours and download information while you sleep. But there's no documentation to support my theory; I simply don't know how the sleep mode could be addressed through software. While the sleep mode uses less battery power than the awake mode, it still consumes more of the machine's juice than the off mode. Perhaps later software implementations will make use of this peculiarity.

SOFTWARE

The ROM-based software includes CP/M 2.2, WordStar-To-Go, Personal Filer, TELCOM, and Calc-To-Go, a spreadsheet. The MicroPro WordStar is a subset of the full 8-bit CP/M version; people who have grown up with it on other machines will adapt quickly. The CP/M implementation is interesting, to say the least. You can control it almost totally through the opening menu and the function keys. The CP/M commands for TYPE, RENAME, PIP, STAT, and ERASE are on function keys 1 through 5, while additional commands are available by calling up an option macro and tapping the same function keys. I could find no CP/M assembler commands, however, and some of the CP/M commands varied from their disk-based counterparts.

(continued)

The CP/M possibilities can be expanded with the optional disk drive. When the 8401A is used as a true laptop, without an external storage device, the 64K bytes of RAM is actually divided in half, with 32K bytes used to hold the ROM-based software (copied from ROM into RAM) and the other 32K bytes available to store the files created by the software. You can store up to 31 files. With the optional disk drive or with a plug-in external RAM cartridge, NEC offers a "32K-byte CP/M Mode," and files can be stored externally. With the "64K-byte CP/M Mode," the machine with a disk drive (but not with the plug-in RAM cartridge) can operate as a fairly standard CP/M desktop. Much disk-based CP/M software, however, requires a screen 80 columns wide by 25 lines deep, so an optional monitor would be necessary.

Notably missing from the NEC is built-in programming capability; if you want BASIC, you have to buy it separately and load it from an optional tape recorder or disk drive.

Calc-To-Go is another MicroPro product and can hold a spreadsheet 64 columns wide and 256 rows deep, or 16,384 cells. That's more than twice as much capacity as the CALC program on the Tandy machine. Since the NEC's display shows a full 80 columns, you can fit the full width of Calc-To-Go on the LCD screen. Files created with Calc-To-Go can be stored in the data interchange format (DIF) and transferred to a desktop microcomputer using a spreadsheet that incorporates DIF files, such as VisiCalc.

NEC's ROM telecommunications software, TELCOM, is a complete implementation that takes full advantage of the machine's built-in 300-bps modem; it also lets you use an external 1200-bps modem. The program uses the machine's function keys to change communications parameters, to automatically dial numbers and log on, to upload and download, to list filenames on a disk, and to break a connection quickly. The documentation on TELCOM is easy to understand yet goes far enough to show you exactly how the little NEC can establish communications with a Digital Equipment Corporation VAX minicomputer. In addition, instructions are given for connections with other computers, such as IBM PCs and Apples.

Personal Filer, the database manager, allows records to hold 13 lines of type, 80 characters across. The program lets you sort files alphabetically on any named field, delete records, edit records, search for character strings, and scroll through files forward and backward. If you have telephone numbers in your database, Personal Filer can dial them for you.

If you pay the price for a disk drive, the world of CP/M 2.2 opens and you have access to thousands of existing programs. CP/M 2.2, however, is somewhat of an obsolete 8-bit operating system. Few programs being written these days are crafted with CP/M 2.2 in mind.

WHY A LAPTOP?

The most important question about the NEC and the Tandy 200 has nothing to do with software. What you really have to ask yourself before forking over $1000 is, "Why do I want a laptop and what am I going to do with it?"

Journalists and other traveling writers can make good use of the Tandy 200, and they probably wouldn't need the extra accessories. Tap in your notes, work on them in the hotel room, and transmit the finished story to the newsroom, all for about $1000. There's nothing heavy to lug around, either. Well-heeled students could use the machine to take readable lecture notes. The built-in scheduler and spreadsheet would enable a frequent flyer to get some real work done in what is usually dead air time, assuming the airline on which you are traveling lets you use portable computers.

A buyer of the NEC machine can enjoy the same advantages; however, the screen display might not be sufficient. The NEC is potentially much more useful than the Tandy, but if you can't read what you're entering, it won't do you much good. ■

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Fast Development

MIX C includes a fast single pass compiler and an equally fast linker. Both are executed with a simple one line command. Together they make program development a quick and easy process.

Fast Execution

The programs developed with MIX C are fast. For example, the often quoted prime number benchmark executes in a very respectable 17 seconds on a standard IBM PC.

Standard Functions

In addition to the functions described by K&R, MIX C includes the more exotic functions like *setjmp* and *longjmp*. Source code is also included.

Special Functions

MIX C provides access to your machine's specific features through BDOS and BIOS functions. The CHAIN function lets you chain from one program to another. The MSDOS version even has one function that executes any DOS command string while another executes programs and returns.

Language Features

- Data Types: char, short, int, unsigned, long, float, double (MSDOS version performs BCD arithmetic on float and double-no roundoff errors)
- Data Classes: auto, static, extern, register
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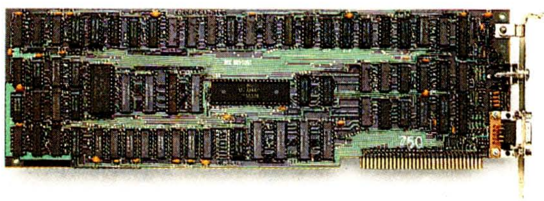
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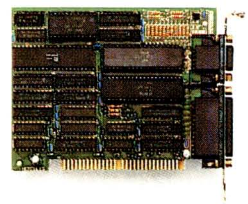
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B

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	IBM Color Adapter $244	Hercules Color Card $245
1. Compatibility	Runs hundreds of graphics programs.	Runs the same hundreds of graphics programs. "The Hercules Color Card is so nearly identical to the IBM Color/Graphics Card that it's almost uncanny." PC Mag.
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4. Flexibility.	Can't always work with a Hercules Graphics Card.	Always works with a Hercules Graphics Card by means of a software switch.
5. Warranty.	90 days.	Two years.

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S·O·F·T·W·A·R·E· R·E·V·I·E·W

Golden Common LISP

An advanced LISP environment for microcomputers

BY BRUCE D'AMBROSIO

Golden Common LISP (GCLISP) is an extended subset of Common LISP that supports more than 400 primitives and includes stack groups, macros, closures, streams, and other advanced LISP features such as GMACS, an integrated, sophisticated EMACS-like editor.

GCLISP also comes with two books, *LISP* by Patrick H. Winston and Berthold K. Horn and the *Common LISP Reference Manual* by Guy Steele, together with a fat binder containing the GCLISP documentation and disks. Thoughtfulness and attention to detail are immediately apparent in the packaging and seem equally apparent in the product itself.

Two weeks, several hundred lines of LISP code, and tens of GMACS hours after opening the package, my initial impression has been confirmed. The wizards at Gold Hill Computers have not squeezed an entire LISP-machine programming environment into those five disks ("LISP machine" refers to a $100,000 high-end system developed at MIT in the late 1970s specifically to execute LISP and programmed entirely in LISP). However, they have packed an amazing amount of functionality and performance into GCLISP, and, with a few caveats, I can recommend it as a LISP system worth serious consideration for several uses.

GCLISP seems intended for use as a training system for learning LISP. Two of the five disks included in the GCLISP package are devoted to an extensive LISP tutorial, and I can think of no other reason for the inclusion of the Winston and Horn book.

It might also be used as a system for developing serious (as opposed to toy or homework exercise) programs. These programs might be stand-alone or serve as the user-interface portion of larger programs running on larger machines. Finally, you might use GCLISP as a delivery vehicle for systems developed on larger LISP machines. The cost of an IBM PC is about one-fortieth the cost of a LISP machine, so this might offer an inexpensive way to distribute artificial-intelligence (AI) systems.

I will comment separately on each of three components of GCLISP: the language and interpreter, the development environment including the GMACS editor, and the LISP tutorial. While all three components are interrelated and the dividing lines are somewhat arbitrary, the distinctions are useful for review purposes.

THE GCLISP INTERPRETER

GCLISP is a variant of Common LISP (a standard LISP blessed by the Department of Defense) and is a synthesis of many of the best ideas from previous experimental and research LISP systems (e.g., MacLISP, Franz LISP, Zetalisp, Scheme, and Nil). Unfortunately, GCLISP is a variant, not a fully faithful implementation.

The variances are of two types. First, GCLISP is a subset. This is not unreasonable since the complete language is large and would never fit in the 640K-byte memory limitation of MS-DOS. Second, GCLISP does not follow Common LISP's rules for variable scoping. These rules specify how the interpreter is to determine the value for a variable referenced within a function and not declared as either a parameter or local to the function. The Common LISP specification calls for lexical scoping (it looks at the program listing and uses the value assigned in the function that most immediately encloses the current one). But GCLISP is dynamically scoped (it uses the most recently assigned value for the variable). In this, GCLISP follows the tradition for LISP interpreters, which historically have implemented dynamic scoping. Lexical scoping has some theoretical advantages but is difficult to implement efficiently in an interpreter.

The choice of dynamic scoping for GCLISP is a serious problem in that some advanced LISP constructs cannot be written in GCLISP so they will work correctly in a true Common LISP system. This is perhaps not crucial for many applications,

(continued)

Bruce D'Ambrosio (555 Tulsa St., San Lorenzo, CA 94580) is a Ph.D. student at the University of California at Berkeley. He is doing research in efficient reasoning.

AT A GLANCE

Name
Golden Common LISP

Type
LISP interpreter and development environment

Manufacturer
Gold Hill Computers
163 Harvard St.
Cambridge, MA 02139
(617) 492-2071

Format
Five 5¼-inch floppy disks

Computer
IBM PC, XT, AT, or compatibles; DEC Rainbow; Wang Professional Computer

Features
LISP Interpreter, GMACS editor, debugging tools, and tutorial system

Documentation
100-page user's guide, 200-page reference manual
LISP by Winston and Horn
Common LISP Reference Manual by Steele

Price
$495

since novices will never be aware of the difference as long as they follow a few simple conventions regarding variable use. The combined effect of these differences is that programs will not be easily transportable between GCLISP and more faithful Common LISP implementations unless they are originally implemented with the restrictions of GCLISP in mind. Also, the impact of the scoping-rule differences can be difficult for a novice to understand, and this reduces the utility of Golden Common LISP as a training system for Common LISP.

Aside from these variations, the GCLISP interpreter seems to faithfully implement a thoughtfully chosen subset of the Common LISP specification. For example, I could enter and run (with only minor modification) several pages of Common LISP code I had been developing on a Symbolics 3600 (a LISP-based personal computer derived from the MIT LISP-machine research).

GCLISP has a wide selection of primitive functions, including arrays (one-dimensional only, with no support for bit arrays), stack groups (a primitive mechanism out of which you can construct various forms of multitasking systems), defstruct (the LISP equivalent of Pascal records—GCLISP doesn't support subfields of arbitrary bit length), streams (the Common LISP input/output facility), macros (a facility that lets the skilled programmer extend the LISP language), readtables (LISP lets you redefine the meaning of each character in the basic character set), and a simple window system.

Those features that are part of the Common LISP specification (stack groups and windows are not) are implemented in a "compatible subset" of the standard. However, very few aspects of Common LISP are implemented in their entirety. Constant cross-reference between the Common LISP reference manual and the GCLISP reference manual is necessary to find out what features are valid. Also, a number of features are missing, including packages (despite what the documentation says, packages are not currently supported), bignums (arbitrary-precision integers, much appreciated by the symbolic-math folks), transcendental functions (e.g., sine, cosine), rational numbers, and hash tables.

In general, GCLISP retains the most useful aspects of any feature and omits those of more limited utility. But the cuts are deep, and anyone hoping for a full Common LISP implementation will be disappointed. Some features are implemented separately from the core interpreter and loaded only on demand. This permits a large number of language features, much larger than could all fit into memory at once. This is wonderful as long as you don't need all those features in any one program. And there's the rub. GCLISP wants lots of memory—more than MS-DOS on an IBM PC will support. The minimal interpreter requires about 250K bytes, and, once I loaded a few standard LISP features, my 512K-byte system had only 18,000 cons cells and about 80K bytes of atom space left. This was enough to load a typical program of several thousand lines, as long as it didn't create many large data structures. But a major piece of the programming environment, the editor, hadn't been loaded yet. On a 512K-byte system you can load either the editor or a large program, but not both.

SPEED

GCLISP is not the fastest LISP I have ever run, but its overall speed is quite respectable. As shown in table 1, it is almost as fast as the Franz LISP (a LISP system developed at the University of California at Berkeley) interpreter running on a VAX-11/750. On a PC, muLISP is faster, but it's a highly nonstandard LISP and cannot use as much memory as GCLISP. XLISP is a public-domain LISP interpreter written in C by David Betz. The version I used was extensively modified by a friend, Frank Korzeniewski, and compiled using Digital Research's C compiler under the large-memory model.

One way to increase execution speed in LISP is to use a compiler. Typically, those functions that you

have already debugged are compiled and loaded into the environment as compiled functions, while those under development are executed interpretively. That way, you get the best of both worlds: the speed of compiled code for most of the overall system, and the flexibility and debugging support of an interpreter for those portions still under development.

Unfortunately, GCLISP does not come with a compiler. Gold Hill Computers has announced one, initially to be available in mid-1984, but now scheduled for release before the end of 1985 together with a large-memory (read 80286) version of GCLISP. The compiler has been announced for both versions of GCLISP but will apparently be more convenient to use in the large-memory system. Lexical scoping is also supposed to be part of the new improved GCLISP due at that time. I suspect that memory limitations will grow more restrictive with this release.

THE GCLISP ENVIRONMENT

The environment includes all those aspects of a language system outside the syntax and semantics of the language itself. For GCLISP, this is the LISP listener, use of the keyboard, error handling, debugging facilities, and the editor.

LISP, like BASIC, is interpreted. That means that the interpreter is "listening" to the keyboard, waiting for you to enter an executable statement. The 17 "keychords" (combinations of Ctrl or Alt with another key or keys) provide a variety of support functions, such as invoking the editor or tutorial system, help, and debugging support. One that suggests the power and convenience of a good LISP programming environment is the Alt-L keychord, which prompts for a function name and then displays its argument list. (How often have you been writing a line of code invoking some function and been unable to remember the correct argument sequence? This is likely in LISP, since the standard style uses many short functions.)

Another important part of a good programming environment is error detection and recovery. GCLISP is reasonably competent at error detection but provides minimal recovery capability. Like most of the larger LISP systems after which it is patterned, GCLISP will trap references to "unbound symbols" (variables that have never been assigned a value), arithmetic overflow and underflow errors, type errors (such as attempting to add a character string to a number), attempts to exceed array bounds, and other run-time errors. Once an error has been detected and reported, the system enters a "break level." Again, this is a standard LISP technique—at this point you can enter any executable LISP statement just as you can at the top level, but it is executed in the context of the error (with all the variable values in effect). This facility is useful for displaying the values of variables (for example, the parameters of the routine executing at the time the error was detected). The Ctrl-B keychord displays the control stack, but unfortunately you cannot move around in the stack and examine locals in different procedure invocations as you can in many LISP systems. GCLISP takes the somewhat unusual but useful tack of displaying the stack by showing the actual LISP forms in evaluation. A sample display is shown in figure 1.

Unfortunately, once you have detected an error in GCLISP and found out why things went wrong, it is impossible to continue. In a few LISP systems, when evaluation stops (because, for example, the program attempts to reference an unbound symbol) you can assign a value on the spot and continue evaluation. In GCLISP, you can assign a value, but the only break level from which you can continue is a user-inserted call to the break function. Once the interpreter detects an error, the only way to restart execution is to abort (return to the top level) and start over.

Error detection and recovery are supplemented in a good LISP programming environment by various debugging support packages. In GCLISP these include a trace facility, step facility, and break function. The trace facility lets you specify the names of functions to be traced. Then each time one of the named functions is entered or exited, that fact is displayed on the screen along with

(continued)

Table 1: *Sample execution times for GCLISP compared with the times for a number of other LISP implementations. Where two columns are presented, the first is for interpreted code and the second is for compiled code. All times are in milliseconds for a single execution of the named function. Note that the speed measurements are rough and will vary among individual systems.*

Operation	GCLISP PC AT	GCLISP IBM PC	muLISP IBM PC	XLISP IBM PC	Franz LISP VAX-11/750		Zetalisp Symbolics 3600	
Iteration	0.6	1.8	2.1	35	1.0	0.4	0.4	0.004
List create	3.0	9.0	1.5	65	4.2	3.1	1.1	0.3
CADDDR	0.4	1.1	0.6	25	0.7	0.3	0.3	0.005
Structure create	4.0	9.1	3.5	—	6.9	4.2	12.0	0.55
Structure reference	0.6	1.7	0.5	—	1.9	0.9	2.4	0.008
Function call	0.2	0.4	0.1	—	0.7	0.4	0.4	0.006
Closure application	0.4	1.2	—	—	1.9	1.3	0.4	0.09

parameter values (on entry) or returned values (on exit). You can't "conditionally" trace a function in GCLISP; that is, you can't ask to see its execution traced only when some condition is satisfied (e.g., when it is executed from within some other function).

The step facility is nicely implemented. It lets you see each step in the execution of any arbitrary LISP expression. You have two basic options when stepping through a computation. The down-arrow key resumes evaluation and stops at the next level of detail in the current expression. The right-arrow key completes evaluation of the current expression and stops before beginning evaluation of the next expression at the same level. Finally, you can insert the break function at any arbitrary point in a LISP expression. When executed, it interrupts the interpreter and returns control to the console in the same manner as a detected error.

GMACS Editor

Perhaps the most powerful aspect of an integrated LISP environment is the editor. GCLISP provides GMACS, an EMACS-like editor that is fully integrated into the LISP environment. It supports multiple (two) windows (you can cut and paste across windows) and more buffers than I can use, is reasonably quick (although it's not hard to type ahead of it), and does preemptive scrolling.

Most noticeably lacking from GMACS are an undo command and the ability to bind key sequences. If those seem fairly primitive facilities to you, it's likely that your favorite advanced EMACS feature is missing also, but enough of EMACS is there for most EMACS users to feel relatively comfortable. Also, GCLISP comes with all the sources for the editor (in LISP, of course) and describes key bindings in a file called EDCOMTAB.LSP that is fairly easy for a hacker to customize to his or her heart's content.

Most important, GMACS is an integral part of the LISP environment. Besides little features like parentheses balancing, expression indentation, and cursor positioning and delete functions that work for S-expressions (the basic LISP syntactic form), GMACS provides keychords to evaluate function definitions, evaluate S-expressions, display argument lists and documentation, and macroexpand an expression.

All these features mean an incredibly rapid debug cycle. Suppose, for example, you are debugging and discover that you need to add a function call to function *y* within function *x*. All you do is enter the editor (via a single keychord, Ctrl-E) and edit the change into function *x*. Now suppose that you forgot the calling sequence for function *y*. Just depress the Ctrl-Z-L keychord and enter the name of function *y*. GMACS displays the argument list for function *y* on the screen. Once you have finished editing the definition of function *x*, press Ctrl-Z-C, and the definition is evaluated. Finally, press F1 and you are back in the LISP listener, ready to continue debugging. Since the entire system is memory-resident, most of this happens in less time than it took to read this paragraph.

All this is wonderful, but unfortunately the quality of the GMACS implementation is not up to the standard set by the rest of GCLISP. In the version I used (1.0), several annoying bugs occurred in the cursor positioning and display-refresh logic, and the system was slow enough to be occasionally annoying. Also, it takes more than two minutes to initially load the editor from floppy disk.

The most annoying problem is that once I loaded the editor, I had only enough room left on my 512K-byte system to edit one modest-size (about 20K-byte) file. And once the file was loaded, I had no room left to load any LISP programs for debugging. That seriously crimps the utility of GCLISP as a development system. However, there are several alternatives. Apparently, GCLISP can use memory beyond the 640K bytes that MS-DOS supports, although I haven't actually tried this to see if it works. Some microcomputers (the DEC Rainbow and the Wang, for example) are configured to directly support more than 640K bytes. GCLISP will use all available memory in these cases. Finally, you can always reserve 60K to 100K bytes of memory for a separate DOS

```
* (setf b 3)
3
* (+ 1 (+ a b))
ERROR:
Unbound variable: A
1> ^B
(BACKTRACE)
(+ A B)
(+ 1 (+ A B))
NIL
1> (setf a 4)
4
1> (continue)
Can't CONTINUE from this error, use CLEAN-UP-ERROR.
```

Figure 1: *A sample error-detection and stack display taken from a* GCLISP *screen dump. For purposes of clarity, user input appears in color.*

partition and use a small stand-alone editor rather than the built-in GMACS. In this case, the interface is through files and you lose the wonderful integrated editing facilities described above, but you still have the GCLISP interpreter and debugging facilities.

THE TUTORIAL SYSTEM

To help you learn the language, GCLISP includes San Marco Explorer and Inspector, some of the most extensive and well-executed tutorial material I have seen. The Explorer is an extensive programmed instruction sequence, occupying two entire double-sided disks. It is coordinated with and covers most of the material of Winston and Horn's *LISP*, widely used in university LISP courses and generally acknowledged as one of the best introductory texts. The San Marco Inspector provides dynamic graphic displays of program execution, enabling simple demonstration of program control flow.

In scope alone, the Explorer is quite impressive. The list of topics covered includes some 60 items, or "slide trays," and each of these consists of 10 or more separate screens of material. I cannot imagine a better, more enjoyable, more painless, or more comprehensive introduction to LISP than this tutorial; it definitely sets a new standard for software instructional material. If you complete this program, you will learn at least as much as you would in the average one-semester college introductory course on LISP.

USES FOR GCLISP

I can envision three separate uses for GCLISP: training, software development, and application delivery. As a training system, GCLISP is unsurpassed. The tutorial is extensive and extremely well done, and the San Marco Inspector is a wonderfully graphic way to examine control flow. The only flaw is the use of dynamic rather than lexical scoping, and this is an issue only when you use GCLISP as a training device for other Common LISP systems.

Similarly, as an application-delivery

The tutorial material is extensive and well executed.

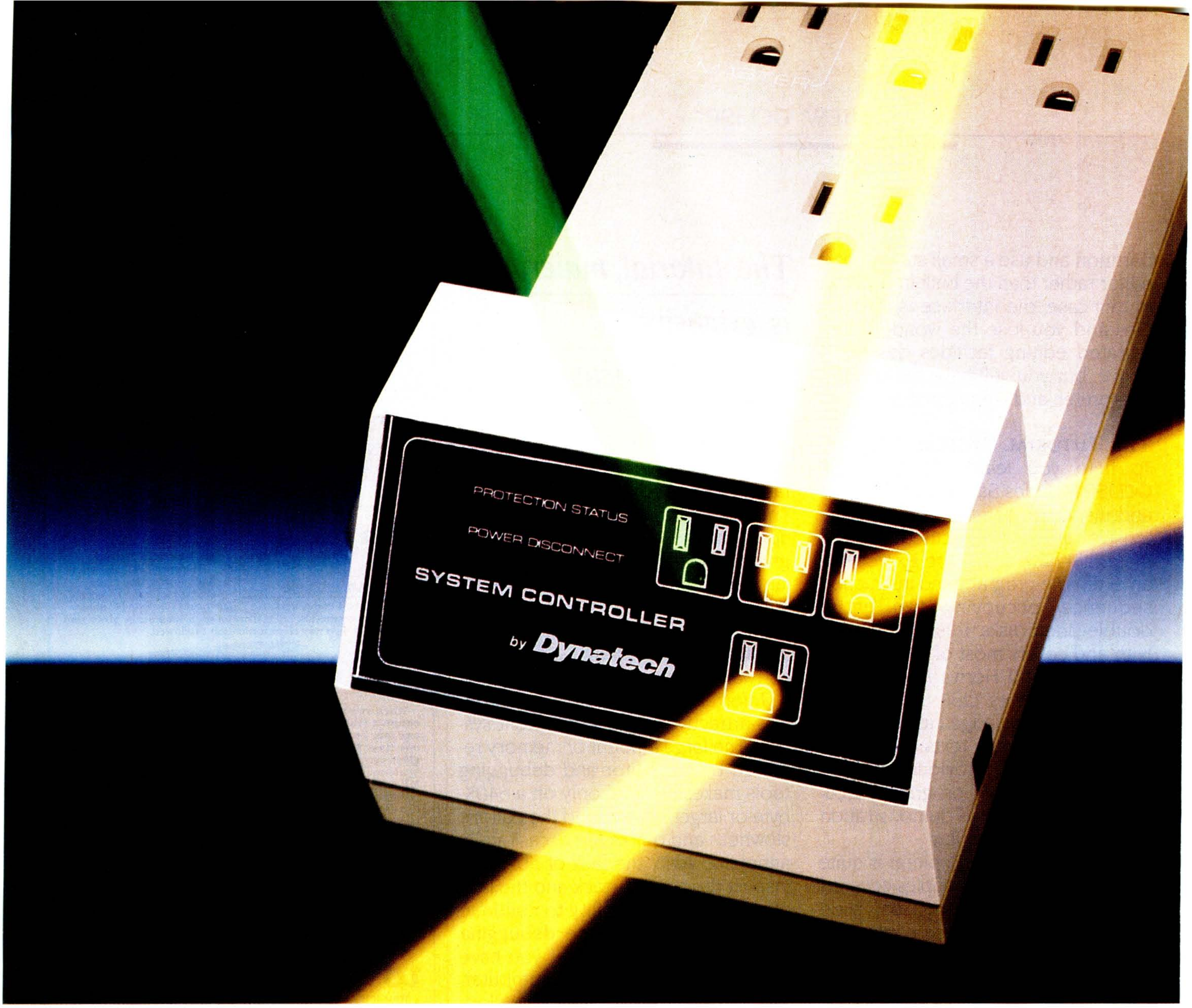
system, GCLISP offers a large subset of Common LISP, a robust implementation, and reasonably fast execution. The availability of streams and windows and the ability to access color graphics, combined with an assembly-language interface, make GCLISP suited for writing high-quality "intelligent" user interfaces, either to other software resident within GCLISP or to software running on other machines.

Unfortunately, GCLISP is somewhat less attractive as a development system. The large amount of memory required by the editor and debugging tools makes it useful only on a 640K-byte or larger system, and the editor's slowness and quirks are occasionally annoying. Also, the lack of ability to inspect the control stack and the lack of error recovery (ability to continue from an error) slow the debugging process. Despite all this, if you have enough memory on your computer, this could be an attractive development system.

CONCLUSION

Golden Common LISP attempts, largely successfully, to provide a high-quality Common LISP programming environment on a microcomputer. It is very similar in feel to the larger LISP systems, and I found myself automatically considering it a peer of those systems.

If you are looking for a way to learn LISP or know you want to work in LISP and can't afford a LISP machine, I highly recommend that you look into this product. However, if you intend to use this system for program development, be prepared to load up your machine with as much memory as you can possibly afford, at least 640K bytes. If you do have enough memory (or, even better, an 80286 machine with 1 or 2 megabytes), GCLISP can provide a solid LISP environment. ■



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S·O·F·T·W·A·R·E R·E·V·I·E·W

The Norton Utilities

Tools for recovering data and managing directories

BY RUBIN RABINOVITZ

Peter Norton's data-recovery tool really recovers lost data. I've used it successfully dozens of times. Will it save every lost file? No. Unfortunately, there are some kinds of damage that the Norton Utilities can't repair. Can you tell before buying the program whether it will help you recover a particular file? The answer to this question has to be inconclusive. There are different kinds of lost data, and sometimes, even when you know how the damage occurred, it is difficult to predict whether it can be repaired.

The simplest kind of loss occurs when you delete a file by using the ERASE or DEL commands in DOS. Even though your directory indicates that the file no longer exists, it hasn't really been erased. What's happened is that an instruction prohibiting DOS from writing in certain areas of the disk has been altered. Your data is retained until information is actually written into these sectors. If you change your mind and decide that you need the discarded data after all, the Norton Utilities will reverse the changes made by the ERASE command and your old file will be restored.

Certain types of equipment failures can produce more serious data losses. Every DOS-formatted disk contains hidden files called the boot record and the file allocation table; these, together with the directory, are used for managing the data stored on the rest of the disk. If garbled information is entered into these files—a common cause is a disk drive out of alignment—your data may become inaccessible. But sometimes the data files themselves may survive this damage; if so, you may be able to recover some or all of them.

RETRIEVING LOST DATA

If you plan to use the Norton file-recovery procedure, you should be careful not to write on a disk with a lost file. You'll risk having new data entered in the sectors containing the file you hope to save. Once the old information has been overwritten in this way, it can't be recovered.

If you did write on the disk, there's still a chance that the sectors holding the erased file were not the ones that received the new data; this depends on factors like how much free space was on your disk and which version of DOS you're using. So until you actually begin the recovery procedure, you won't know for sure whether the lost file was destroyed. Still, it's best not to take chances. Make it a rule to never write on a disk containing damaged files.

Another good idea is to make a copy of your damaged file whenever possible. If you're working with floppy disks, you should use the DOS DISKCOPY command (as opposed to the COPY *.* command); DISKCOPY works by reproducing what's on the source disk exactly, byte by byte, so even deleted data is copied. Carrying out the recovery procedure on a copied version of the damaged file means that if you make a mistake, you'll have a chance to recopy the original and try again.

After taking these precautions, you can begin the file-recovery procedures. In general, for simple problems like unintentionally invoking an ERASE command, you can expect the Norton Utilities to retrieve lost files consistently. When a problem is caused by a current spike, static electricity, or a disk drive out of alignment, it's harder to predict how much of a file can be recovered; this is because so many different varieties of error can occur.

With many types of errors, the Norton Utilities can often help you salvage something. At times you may be able to recover only portions of a file. This is similar to what happens when the CHKDSK procedure in DOS restores only some of the lost clusters (groups of isolated sectors) in a file. In many cases you can save enough of a file to be able to reconstruct the missing portions with little trouble. But for some files, such as those created with spreadsheet programs, even a small amount of data loss can

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some simple formatting and printing options and permits you to add line numbers to documents automatically.

Another series of programs is designed to help you learn about your computer and use it more efficiently. You can test a compatible machine against an IBM Personal Computer, find the addresses in RAM (random-access read/write memory) where application programs are loaded, display a map showing the locations of the files on a disk, read the data in a hidden file, change archive files into read-only files or vice versa, reset screen attributes such as colors and reverse video, or make the computer beep to signal that a command sequence has been executed.

Directory Management

Among other inducements to buy the Norton Utilities, even if you don't need it for recovering lost data, are programs for managing directories. One of these programs, Directory Sort, is very useful. It lets you sort by filename or by file extension, by file size, or by the date or the time a file was created. Directory Sort is a great help for locating files quickly and for organizing large directories.

File Find will be welcomed by hard-disk users. It searches through directories and subdirectories for a specified file. File Find permits you to use the wild-card characters * and ?, letting you search for a range of files with similar names or extensions. List Directories is another Norton program for managing hard-disk directories. It displays all the directories and subdirectories that are contained on a disk.

File Size supplements the information given in DOS directories. When File Size displays dates, it lists the day of the week along with the other information. The display also gives you the amount of space occupied by the data in a file, the amount of space taken up by a file on the disk (the figure for the data plus whatever room may be in partially filled sectors), and the amount of space needed to copy the file onto another disk (this number is necessary when the sizes of the clusters on two different disks aren't the same size).

Using the Program

Working with most of the smaller Norton programs is easy. The instructions are clear and the command sequences are simple. Learning to use the file-restoration program, however, is somewhat more difficult. Unlike earlier releases of the Norton Utilities, the new version (3.0) has its menus arranged in a tree array. To use a function available in menu 2.3, you start at the main menu, then go to menu 2, then go to menu 2.3. But the manual has no list indicating where each function is located; instead, you're advised to experiment with the program and assured that you'll quickly catch on.

Well, maybe. Although I was familiar with an earlier release of the Utilities, it still took some guesswork to get from one part of the program to another. First-time users of the program—some of them still numb from the shock of a FATAL ERROR message—may not be in the mood for experimenting. Without detailed instructions, they could add to the damage they're trying to fix.

A valuable addition to the manual would be a chart showing the contents of all the file-repair menus and the command keystrokes needed to get from one menu to another. Also, a more detailed set of troubleshooting procedures and a more comprehensive discussion of the causes of data loss would be useful.

In general, I think the Norton Utilities is an excellent set of programs. It provides a good way to learn more about how a computer works and how information is stored on disks. Among the many Norton programs, there are a few that you'll probably use regularly; the rest may initially seem less valuable. But they're like specialized tools: In some situations, you'll find them indispensable. This is certainly true of the Norton data-recovery procedure. Using it once to retrieve a valuable file can make it pay for itself. Not many programs can promise as much. ■



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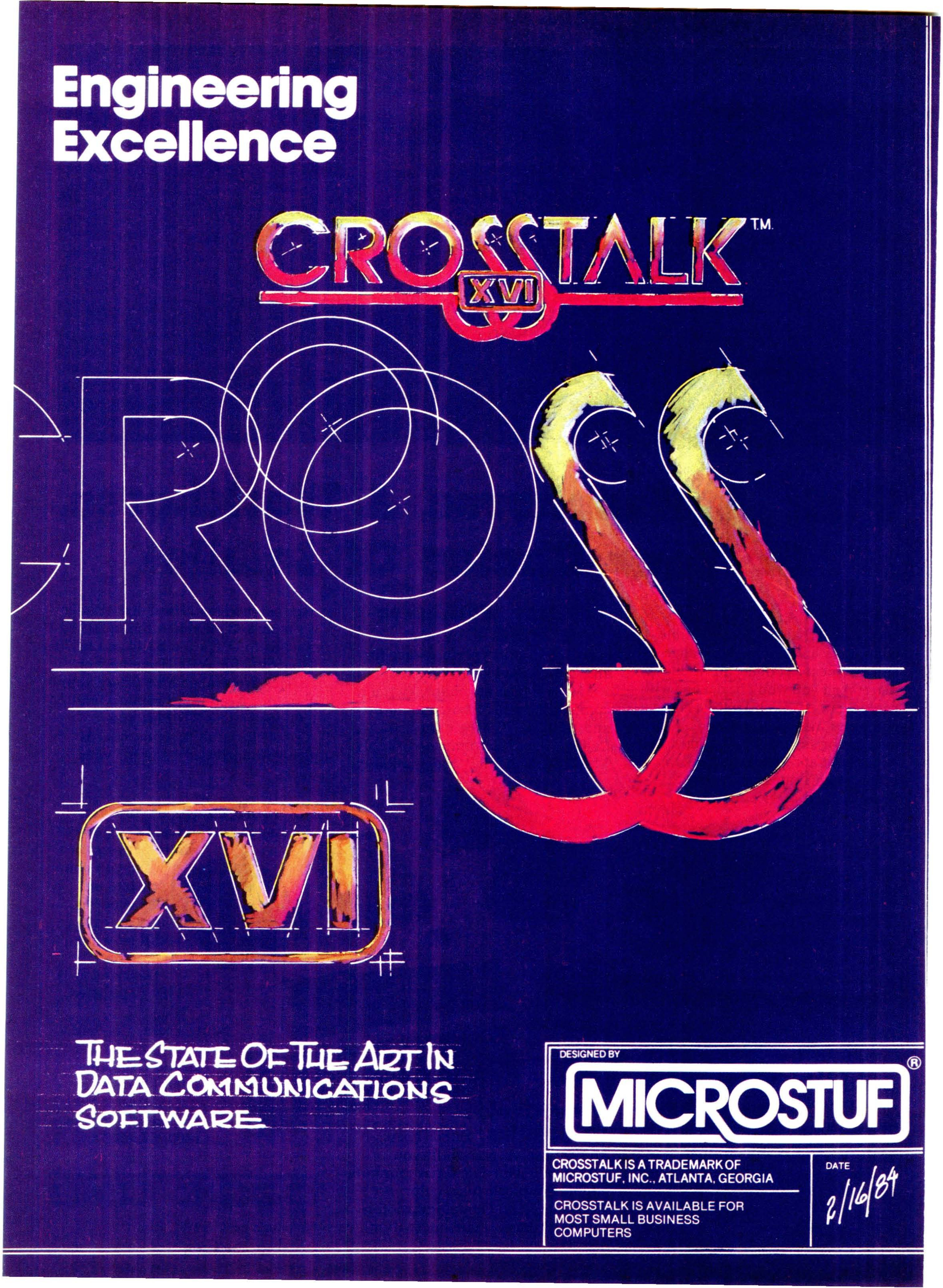
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HyperDrive for the Macintosh

A class act with caveats

BY GREGG WILLIAMS

General Computer Company's HyperDrive isn't much to look at. In fact, the only difference between a HyperDrive-equipped Mac and a normal one is a sticker just below the screen (see photo 1). But that's one of the HyperDrive's best features: There *isn't* anything to look at. It looks like a normal Macintosh, but *inside* is a 10-megabyte (or, in the case of HyperDrive 20, a 20-megabyte) hard disk. A HyperDrive-equipped Mac fits in the same carrying case and still has two free serial ports (many add-on Mac hard disks use one of the two serial ports). As an added bonus, a HyperDrive-equipped Mac uses itself as the start-up disk, eliminating the usual practice of having to start up with a special floppy disk.

The HyperDrive is fast, unobtrusive, and easy to use. Unfortunately, I had some problems that might affect your view of it.

INSIDE THE HYPERDRIVE

The HyperDrive is an add-on hard-disk drive installed inside your 512K-byte Macintosh by one of General Computer Company's authorized dealers. Formerly, the company offered its own 512K-byte upgrade; it no longer does. The disk is housed in a shock-mounted case; the dealer also installs one circuit board, an auxiliary power supply, and a small fan (see photo 2). This adds just under 5 pounds to the Mac's weight (just over 5 pounds for the HyperDrive 20).

The HyperDrive with installation costs $1695 ($2195 for the HyperDrive 20). GCC provides a 90-day warranty, and the HyperDrive can be serviced by the dealer who installed it or by any authorized Apple dealer (last June, Apple announced that adding a HyperDrive does not void your Mac warranty). You can also purchase a one-year maintenance contract covering the HyperDrive for $195 ($250 for the HyperDrive 20).

I found the HyperDrive and the HyperDrive 20 to be identical except for the amount of storage they deliver. From here on, anything I say about the HyperDrive will refer to both models unless I explicitly indicate the HyperDrive 20.

RUNNING THE HYPERDRIVE

A HyperDrive-equipped Mac uses modified software that partitions the hard disk into as many drawers as you want. A drawer is essentially the same as a disk drive; it has its own desktop icon that opens, like a normal Macintosh disk-drive icon, to a window containing its contents. Unlike a normal disk, a drawer can take up to 16 megabytes of disk storage; the only other limitation is in the number of files it can store in one drawer. (The Macintosh, like many other computers, was not designed with hard disks in mind. Vendors of add-on hard disks modify the existing operating system so the hard disk looks like multiple floppy disks. The Macintosh floppy disk contains space for only 128 files, a maximum large enough for the standard 400K-byte 3½-inch floppy disk but not for a larger mass-storage device.)

A HyperDrive drawer can be larger than 400K bytes but still has a natural limitation in the number of files it can hold. GCC has altered the Finder so a drawer can contain up to 128 (normal), 256, or 512 files. A drawer allocates storage from the hard disk in units of 256K bytes—a drawer with just one file in it takes 256K bytes, and a set of files totaling 257K bytes takes 512K bytes.

Because of the way the HyperDrive allocates disk space, drawers have an interesting quirk: The available memory messages in the upper left corner of various drawer windows might be different (they should be the same, since they reflect the amount of memory available on the entire hard disk).

THE MANAGER

Just as a normal Macintosh runs faster if you're not using the external drive, the HyperDrive-equipped Mac runs faster if you have fewer drawers on the desktop. You can

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AT A GLANCE

Name
HyperDrive (or HyperDrive 20)

Type
An internal 10-megabyte (or 20-megabyte) hard disk for the Macintosh computer

Manufacturer
General Computer Co.
215 First St.
Cambridge, MA 02142
(617) 492-5500

Software
Modified System file plus Manager, HyperInstall, Backup, and print-spooling programs

Price
$1695 ($2195 for HyperDrive 20); optional HyperCare maintenance contract is $195 ($250 for HyperDrive 20)

use the Manager program (included with HyperDrive) to open or close drawers. Closed drawers are invisible to the Macintosh; they do not appear on the desktop, nor do they slow start-up and launch times (launch time is the amount of time needed to start a selected program). The Manager gives you a "Drawers" menu that lists all existing drawers. You can check (open) and uncheck (close) a drawer by selecting its name.

With the Manager program, you can also initialize, format, or non-destructively test the hard disk, create and delete drawers, change a drawer's password, and do garbage collection (reclaim fragmented areas of storage too small to use). The Preferences screen lets you modify the HyperDrive's behavior in several ways (see photo 3).

THE DRAWERS ACCESSORY

To the Macintosh, the Manager is just another program, and entering and leaving it take time. As a partial, faster substitute, GCC has added a new desk accessory titled Drawers. When you launch the Drawers accessory, the Mac adds the Drawers menu to the title bar and you can open new drawers, even while you're inside an executing program.

Occasionally, you can't close drawers this way and must do it via the Manager program. This happens when the HyperDrive software sees that a file is still open and might happen when you try to open or close a drawer created with the 256- or 512-file directory.

BACKUPS

GCC includes a Backup program that lets you copy files or some or all of the drawers, either to another part of the HyperDrive or to multiple floppy disks. Once you have done that, you can later do an incremental backup on one or more drawers—this is faster because it updates only the data that has changed since the last backup.

However, each incremental backup takes at least one disk, even if you have changed only a few files. This is



Photo 1: A *Macintosh computer with a* GCC HyperDrive 20 *20-megabyte hard disk in it.*

wasteful, and you will eventually want to do a complete backup (which will use disks more efficiently).

PRINT SPOOLER

The print-spooling utility supplied with the HyperDrive is an innovative and useful program that uses the free space on the hard disk (i.e., disk-storage capacity not used by any open or closed drawer) to spool any output that goes to the printer. All other Mac print spoolers to date print only text files. (Ordinary text spoolers use a small amount of the Mac's memory to store the file in ASCII format and then print it in draft mode. The Mac cannot spare enough memory to save the high-resolution graphics image that it sends to the printer when a document is printed in standard- or high-quality modes, but a HyperDrive-equipped Mac with several unused megabytes of storage can.)

You can install the print-spooling capability by moving the Spooler Install program onto the Startup drawer and launching it; the print-spooling capability is available automatically when you restart the computer until you remove it by running the Spooler Install program again. The feature works well; for example, I started printing a 14-page MacWrite document and found that my Mac was free for other tasks after the printer had produced four pages. (The spooler does not spool everything to disk, only what the printer can't handle; for the first four pages, the Mac was continuously printing the document and saving the rest of it to disk. This is slower than a scheme that would dump everything to disk, but it saves a lot of time.) The spooler continues to print your document, pausing only during times of heavy disk access, even if you leave one application and go to another; however, it does not survive a complete reset or power-down/power-up of the Mac.

PERFORMANCE

The more files that are on the desktop, the longer the Mac takes to start

(continued)

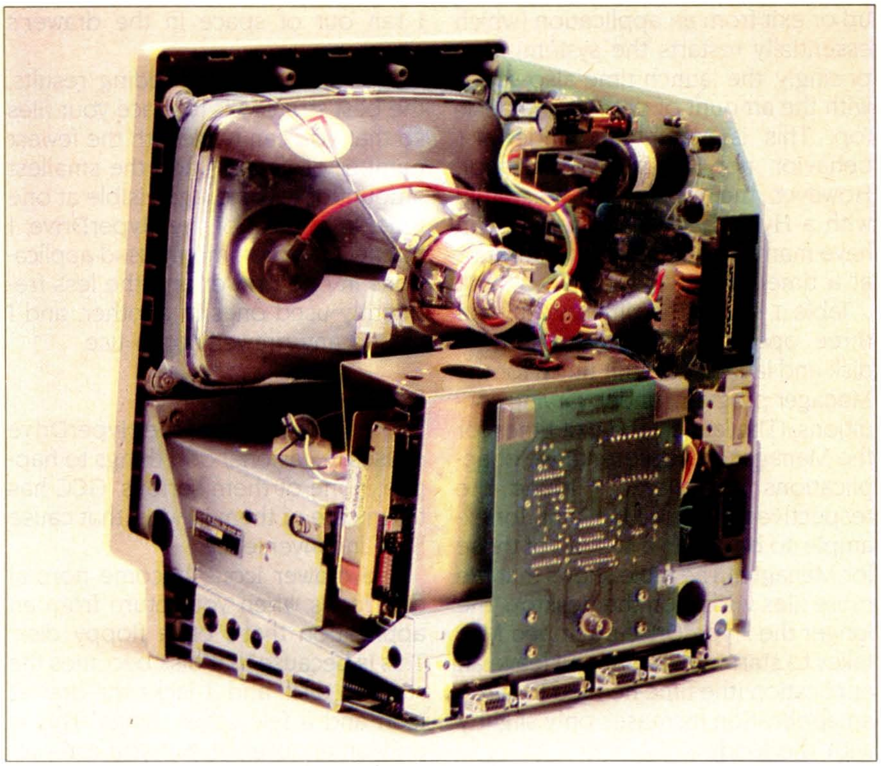


Photo 2: *An interior shot of a HyperDrive-equipped Mac. The hard disk is the vertically mounted box. The circuit board in front of the hard disk is not part of the HyperDrive; it is an enhancement that gives the Mac an external video output jack.*

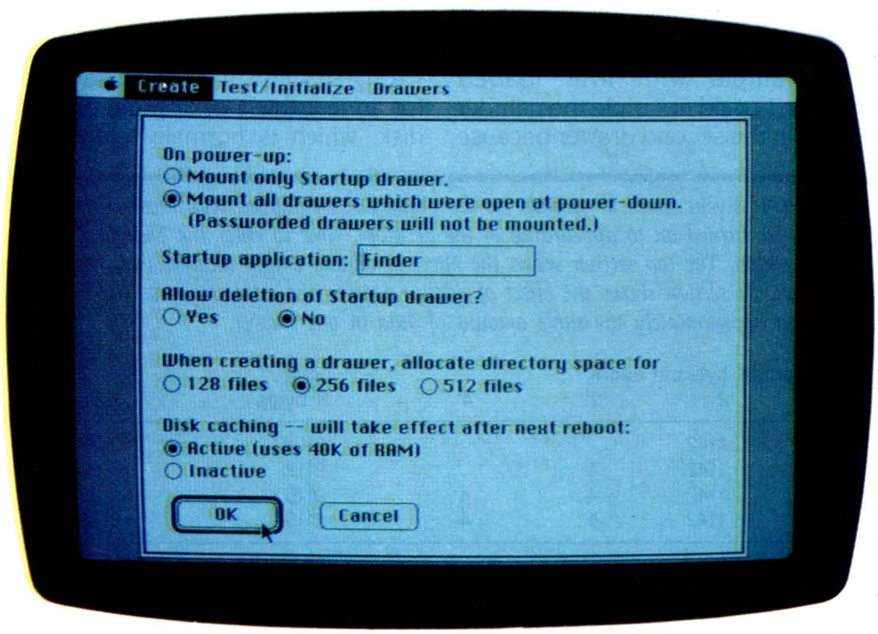


Photo 3: *The Preferences screen. This screen allows you to change the way the HyperDrive works.*

up or exit from an application (which essentially restarts the system). Surprisingly, the launch time also varies with the amount of data on the desktop. This is Macintosh Finder 4.1 behavior, not HyperDrive behavior. However, the problem is magnified with a HyperDrive because you can have many more files on the desktop at a time.

Table 1 shows the timing results of three operations (initial start-up of disk and launch and exit times for the Manager program) under varying conditions. (The launch and exit times for the Manager are representative of applications in general; I found the respective times for MacPaint, for example, to be within a second of those for Manager.) The table shows that the more files visible on the desktop, the longer the HyperDrive-equipped Mac takes to start the system and leave an application (the time needed to *launch* an application increases only slightly with the load).

The table also shows that the overhead of an empty drawer (which takes up 4K bytes) is pretty low, and that there is a slight advantage (never more than two seconds) to putting all your files in one drawer instead of several. Note that the drawers in the last example contain less data than the example with four loaded drawers; I could not triple the number of files in the second drawer because I ran out of space in the drawer's directory.

Because of the preceding results, the best strategy is to place your files so that you can work with the fewest number of drawers and the smallest amount of disk storage visible at one time. In my use of the HyperDrive, I put my more commonly used applications in one drawer and the less frequently used ones in another, and I closed any drawer not in use.

PROBLEMS

The add-on nature of the HyperDrive causes occasional odd things to happen, none of them serious. GCC has taken care of them in ways that cause little inconvenience.

The drawer icons become normal disk icons when you return from an application that's on a floppy disk. This is because that disk becomes the start-up disk, and it lacks the drawer icon and a few other things. This is only an annoyance, but you can prevent it by running a supplied HyperInstall program, which adds the missing elements to the disk.

If you create a drawer and turn the Mac off without putting something in it, you will get a "disk needs minor repairs" alert box the next time you turn on your Mac. Nothing has gone wrong—it's just that the Finder looks for an invisible Desktop file on each disk, which is normally created as soon as you put one file on it. When it doesn't see it, the Finder gives you the "minor repairs" box and creates the Desktop file when you tell it to go ahead with the repairs. This is a function of the Macintosh Finder program, not the HyperDrive.

CAVEATS

I used a 10-megabyte HyperDrive-equipped Mac eight hours a day for two months without a problem. In the month that followed, however, I had one crash that resulted in GCC replacing the unit (GCC said it was a bad disk-controller card), a major software-related problem (somehow the System Folder software got corrupted), and another crash that caused the loss of two drawers. (I use "crash" to denote a system failure that leaves the computer unable to start up from the internal hard disk.) Three times, the fan in the second HyperDrive-equipped Mac made a buzzing sound that went away in about an hour. I will not elaborate on these errors because GCC maintains that it has improved both its software and its method of adding the HyperDrive to a 512K-byte Macintosh.

I received a HyperDrive 20 in late August and used it for about two weeks. In that time, I had several problems of varying severity.

Some 3½-inch floppy disks that usually worked crashed when trans-

Table 1: *Event times in seconds on the HyperDrive-equipped Macintosh. The events measured are time to start up (from computer turned on to appearance of the desktop), time to enter the Manager program, and time to exit it and return to the desktop. The top section shows the effect of adding empty drawers (4K bytes each) to the desktop, which is negligible. The middle section shows the effect of adding data to the extra drawers. The bottom section shows the speed advantage of putting approximately the same amount of data in one drawer.*

Drawers (K bytes in each)				Total		Launch	Exit
1	2	3	4	K bytes	Start-up	Manager	Manager
966	1142			2108	27.0	5.7	9.6
966	1142	4		2112	27.4	6.2	9.8
966	1142	4	4	2116	28.0	6.7	9.9
966	1142	4	4	2116	28.0	6.7	9.9
966	1142	1142		3250	33.7	7.6	16.3
966	1142	1142	1142	4392	42.3	7.5	24.3
970	1142			2112	27.7	7.3	9.6
970	2273			3243	31.4	7.4	14.3
970	3026			3996	33.8	7.3	16.7

REVIEW: HYPERDRIVE

ferred to the HyperDrive. I eventually discovered that, in almost every case, the solution was to remove the System Folder from that disk so the software would go to the System Folder, as modified for the HyperDrive, in the Startup drawer. Tom Westberg of GCC said that his company now recommends that you put all your applications in the Startup drawer, which would prevent this problem.

One time I was unable to open a drawer, even from the Manager program. Westberg said this stems from a complicated algorithm that manages the hard disk; paradoxically, the problem goes away as you use more and more of the HyperDrive's capacity. Westberg said that it rarely happens, and the system software is always able to open at least three drawers before it happens.

Twice, on entering the Manager program, I was given an alert box telling me that "The HyperDrive has not been formatted properly. The only function you may execute at this point is 'Format.'" (I could also quit.) When I quit the alert box and reentered the Manager program, I did not get this message again (formatting the HyperDrive would have erased everything on the disk). Westberg, who was always very helpful, said he thinks that the spurious alert box was a bug in the software.

My last problem occurred as I was writing this review: The HyperDrive crashed whenever I tried to use the internal or external floppy-disk drive. The hardware was probably not at fault; the drives booted and operated correctly when I caused the Mac to ignore the HyperDrive and use a floppy as the start-up disk. I did not have time to correct this error and sent the HyperDrive back to GCC.

CONCLUSIONS

I like the HyperDrive very much, but I can't deny the severity and number of problems I had with it. I might still buy one, but only if my dealer were nearby and he or she reported no problems with previous HyperDrives. ■

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Upgrades for the TRS-80 Model 100

Equipment for adding versatility and convenience

BY TERRY KEPNER

The Radio Shack Model 100 was the first truly portable computer with built-in software. Because of that, it received rave reviews and gained immense popularity. But it was also criticized because it couldn't be expanded with hardware: It lacked a disk-drive interface and options for increasing the memory, for using a video monitor or larger screen display, and for an expansion box.

But all that has changed. You can now increase the memory capacity to 96K bytes with more software, add disk drives, increase the display to a full 80 characters by 24 lines, and add expansion boxes that include real-world interfaces (analog to digital) for connecting to other equipment.

MEMORY MODULES

When the Model 100 was introduced, only Radio Shack sold the 8K-byte memory modules. Now six companies sell the chips for considerably less. (See the text box on page 336 for the sources of products mentioned.) These modules are literally a snap to install: Turn off the computer, remove the back, locate the empty RAM (random-access read/write memory) sockets, plug in the 8K-byte chip modules, and reassemble the unit. Any technician can do the job in 15 minutes, and a brave novice can do it almost as quickly.

MEMORY EXPANSION

The Model 100 gives you 32K bytes of RAM with all the memory sockets filled. The next step in expanding RAM involves the upgrades that use the bus socket located on the bottom of the computer, in the expansion compartment.

PG Design's 32K-byte RAM bank ($325) plugs into the expansion socket and includes its own battery. It uses CMOS (complementary metal-oxide semiconductor) memory, like the internal RAM, and the inclusion of the battery turns the expansion board into a miniature self-powered bank. The unit can be removed for several weeks without losing data. Unfortunately, the board also covers up the access to the expansion ROM (read-only memory) socket, so you can't use any other devices while the "memory bank" is installed. Nor can you transfer data between the external bank and the internal memory. In operation you can use either the internal or the external memory; programs can't span the banks (i.e., you can't have a 40K-byte program or data file). A simple one-line BASIC program is used to switch between the two banks.

Cryptronics offers even more convenience with its 96K-byte expansion memory bank ($425). It fits inside the expansion compartment but doesn't cover the expansion ROM socket. It, too, includes a battery. A program is provided for transferring data from bank to bank.

The next level of memory upgrade is also made by Cryptronics, the PortaPac Z-100 RAM disk. This device plugs into the RS-232C port of the Model 100 and provides storage capacities of 60K bytes ($325), 120K bytes ($395), 180K bytes ($465), and 240K bytes ($535). Each block of 60K bytes is treated as a "drive." The unit measures 1.75 inches high by 6 inches wide by 10 inches deep and weighs 3.75 pounds (including its internal sealed lead-acid battery). The battery is recharged with an AC adapter while the unit is in use; it powers the RAM disk for 2½ to 4 hours of continuous use or 6 to 20 hours of storage time (depending on the amount of RAM). The PortaPac Z-100 includes operating software in internal ROM and a BASIC program you load into your computer and use to control the unit. The disadvantages of the unit are its short memory retention and its hefty amount of radio frequency interference. Radios and televisions can't operate within about 30 feet of the unit.

DATA STORAGE

Permanent data storage for the Model 100 was originally limited to cassette tapes. Now

(continued)

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several choices are available: wafer tape, 5¼-inch floppy disks, and 3½-inch disks, with bubble-memory under development.

Holmes Engineering was first on the scene with its wafer-tape drive system, the Portable Micro Drive (PMD) ($369.50), which operates from the Model 100 RS-232C port. The PMD is about the same size as the Model 100. The drive is battery-powered with an AC adapter/charger and includes its own internal RAM for RAM-disk operation. The wafer tapes are about 20 to 30 times faster than cassette tapes for data saving and loading and are "endless loop" tapes. Micro wafer tapes come in various sizes from 5 to 50 feet. The PMD treats the tapes as "slow" disk drives, automatically searching for sections large enough to store files. (You don't have to worry about "overwriting" other files or programs; the PMD won't let you unless you specifically tell it to erase a tape file.) Like the PortaPac Z-100, the PMD can store only ASCII (American Standard Code for Information Interchange) files and is controlled primarily through the Model 100 TELCOM program.

Standard disk drives and an 80-character by 25-line display on a video monitor are available with Radio Shack's Disk/Video Interface ($799). But this ties you to a desk. If you want portability, you have two choices: the Holmes Engineering Chipmunk and the PICdisc Micro Drive, which both use 3½-inch disks with 360K-byte capacity.

The Chipmunk, available from the Portable Computer Support Group for $599, is a battery-operated unit with an AC adapter/charger. It measures 5½ inches wide by 2½ inches tall by 7½ inches deep and weighs only 2½

(continued)

WHERE TO GET UPGRADES

MEMORY MODULES

RADIO SHACK/TANDY CORP.
1800 One Tandy Center
Fort Worth, TX 76102
$119.95

PURPLE COMPUTING
2068 Ventura Blvd.
Camarillo, CA 93010
$44.95

CRYPTRONICS INC.
11711 Coley River Circle
Suite 7
Fountain Valley, CA 92708
$29

PG DESIGN
66040 Gratiot
Richmond, MI 48062
$48.50

ECONOMY COMPUTER CONCEPTS
Box 2047
North Babylon, NY 11703
$39

I.O. DATATECH
48-60 38th St.
Long Island City, NY 11101
$69.95

HOLMES ENGINEERING
5175 Green Pine Dr.
Salt Lake City, UT 84123
$49.95

MEMORY EXPANSION

PG DESIGN
(see address above)

CRYPTRONICS INC.
(see address above)

DATA STORAGE

Portable Micro Drive
HOLMES ENGINEERING
(see address above)

Disk/Video Interface
RADIO SHACK/TANDY CORP.
(see address above)

The Chipmunk
PORTABLE COMPUTER SUPPORT GROUP
11035 Harry Hines Blvd.
No. 207
Dallas, TX 75229

PICdisc Micro Drive
PERSONAL INTEGRATED COMPUTERS
18013 Skypark Circle
Suite D
Irvine, CA 92714

Bubble-memory device
SOUNDSIGHT COMMUNICATIONS
2807 Pelham Place
Hollywood, CA 90668

EXPANSION ROMs

Lucid, Write-ROM
PORTABLE COMPUTER SUPPORT GROUP
(see address above)

The Ultimate ROM
TRAVELING SOFTWARE INC.
11050 Fifth Ave. NE
Seattle, WA 98125

Multiplan
RADIO SHACK/TANDY CORP.
(see address above)

ROM2
POLAR ENGINEERING AND CONSULTING
Box 7188
Nikishka, AK 99635

PERIPHERALS

Thinview LCD panel
AXONIX
417 Wakara Way
Salt Lake City, UT 84108

PL-1000
ELEXOR ASSOCIATES
Box 246
Morris Plains, NJ 07950

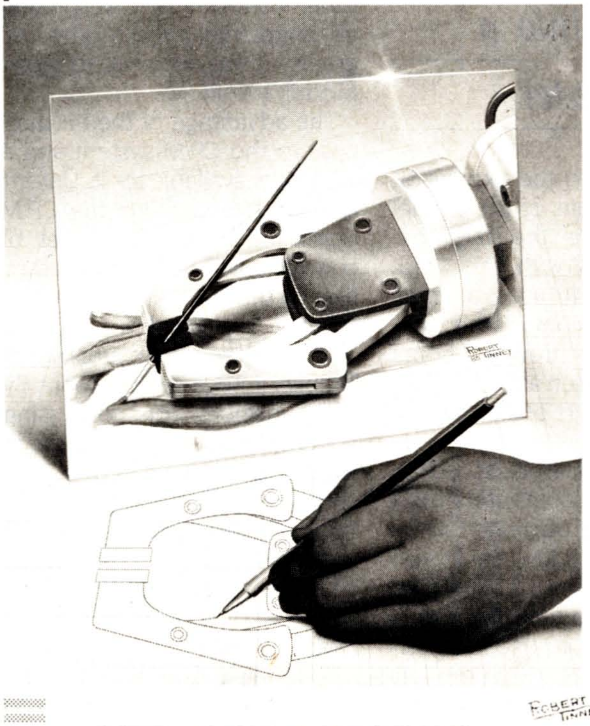
Black Jack modem adapter
MICROPERIPHERAL CORP.
2565 152nd Ave. NE
Redmond, WA 98052

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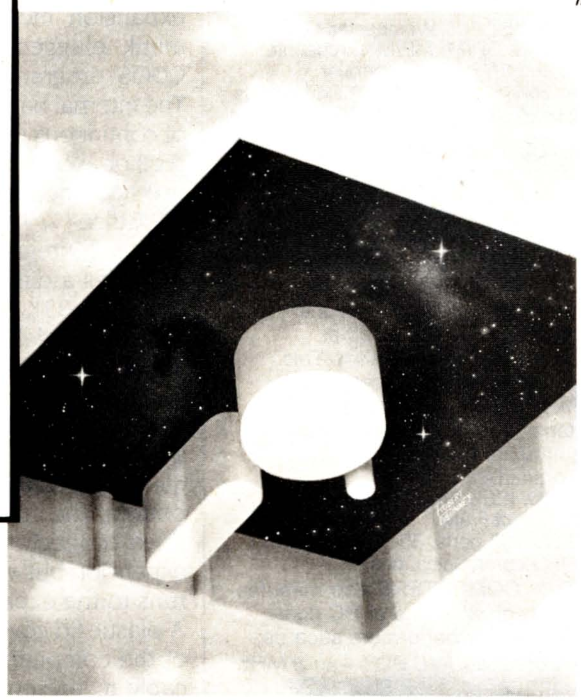
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#B



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PICdisc turns the Model 100 into a CP/M computer.

pounds. It plugs into the expansion socket on the bottom of the Model 100. You can't use the memory-expansion modules with the Chipmunk plugged in. It uses a small CDOS program to control the unit. The internal batteries provide 2 hours of continuous use (such as a disk data sort) or about 12 hours of intermittent use (loading and saving files).

PICdisc ($799) is manufactured by Personal Integrated Computers (PIC) and uses a different approach. It includes a 32K-byte RAM bank and turns a Model 100 into a 64K-byte CP/M computer. (You must have a 32K-byte Model 100 to use PICdisc.) The unit attaches directly to the left side of the Model 100 with a special metal mounting plate you bolt to its bottom. The mounting plate holds the drive connector and attaches to the expansion bus with a short cable that runs to the expansion compartment. A plastic lid covers the entire bottom of the computer and the connecting cable to prevent the mounting plate from scratching tabletops.

With the mounting plate in position, the PICdisc drive can be quickly installed or removed without putting stress on the delicate expansion socket of the Model 100. The mounting plate has an expansion connector for the drive. The bottom lid adds only one-quarter inch to the depth of the Model 100. The PICdisc runs for 2½ hours continuously or about 20 hours intermittently.

The disadvantage of the PICdisc is that it completely usurps the computer's ROM operating system and programs, turning the Model 100 into a CP/M computer. Special software automatically saves a RAM image to disk when you boot the PICdisc, so you don't lose the data in memory. (When you exit CP/M, this image is reloaded into your computer.) And you can pull files out of the RAM image for use in CP/M programs. In other words, PICdisc wasn't designed to complement the Model 100 programs—it was designed to replace the Model 100 ROM.

The advantage of the PICdisc is access to the CP/M system and all the programs available for it. Unfortunately, only PIC supplies the CP/M programs in the 3½-inch format, but the company will transfer programs and files to that format if you supply the original 5¼-inch disk.

The PICdisc system incorporates the T/Maker Integrated Software System, which includes word processing, relational database management, spreadsheet, graphics, and a spelling checker. This almost offsets the disadvantage of losing the Model 100 ROM programs. Once you start using T/Maker, you probably won't notice the loss of the Model 100 native mode.

SoundSight Communications manufactures a bubble-memory expansion device. The device uses bubble-memory modules that are slower than normal RAM but faster than a disk drive, and they never lose stored data until you order it erased. The price runs from $750 to $900 for the first 128K bytes, with possible expansion to 512 megabytes.

The bubble-memory unit is a simple bolt-on case that attaches to the bottom of the computer, leaving the expansion compartment door accessible. It makes the Model 100 about one-half inch thicker. Like the Model 100, it's powered by AA batteries.

Expansion ROMs

ROMs have advantages over RAM-based programs because they don't require any RAM and you don't have to load them into RAM to use them. Lucid ($149.95) and Write-ROM ($149.95) are produced by the Portable Computer Support Group. Lucid is a spreadsheet program that rivals Lotus 1-2-3 in capabilities (except disk I/O routines, of course). Trying to describe all its abilities would require a separate review. Its most unusual

(continued)

feature is that it doesn't require RAM for empty cells; only spreadsheet cells holding data use up memory. Its maximum size is 126 columns by 254 rows.

Write-ROM upgrades the Model 100 by replacing the built-in TEXT program with a more powerful word processor. It has all the features you might expect: margin control, centering, justification, headers, footers, search and replace, and 35 other functions. You can also prepare WordStar-compatible files on it and perform mail-merge functions.

The Ultimate ROM ($229.95) is a collection of three Traveling Software programs on one plug-in ROM chip. The trio consists of T-base, a relational database manager; Traveling Writer, a text formatter; and Idea!, a thought processor that can organize ideas into outlines. All the programs use a Config file that lets you modify them.

Multiplan ($149.95) from Radio Shack is the popular spreadsheet program scaled down to the Model 100. Almost all the features, except disk I/O commands, have been reproduced, including template and data portability to other versions of Multiplan. Its size limit is 63 columns by 99 rows.

For the 8085 machine-language programmer there is ROM2 ($85), a macro assembler/symbolic debugger. The assembler allows macros with symbolic arguments, conditional assembly-code blocks, and label table retention. The debugger allows interactive code patching, interactive code execution, program simulation tracing, single-stepping, breakpoint setting, and other functions. ROM2 is also of interest to BASIC programmers. It includes a renumber utility, lists a RAM directory with file sizes, can copy and compare .DO files, and has a global search-and-replace utility.

PERIPHERALS

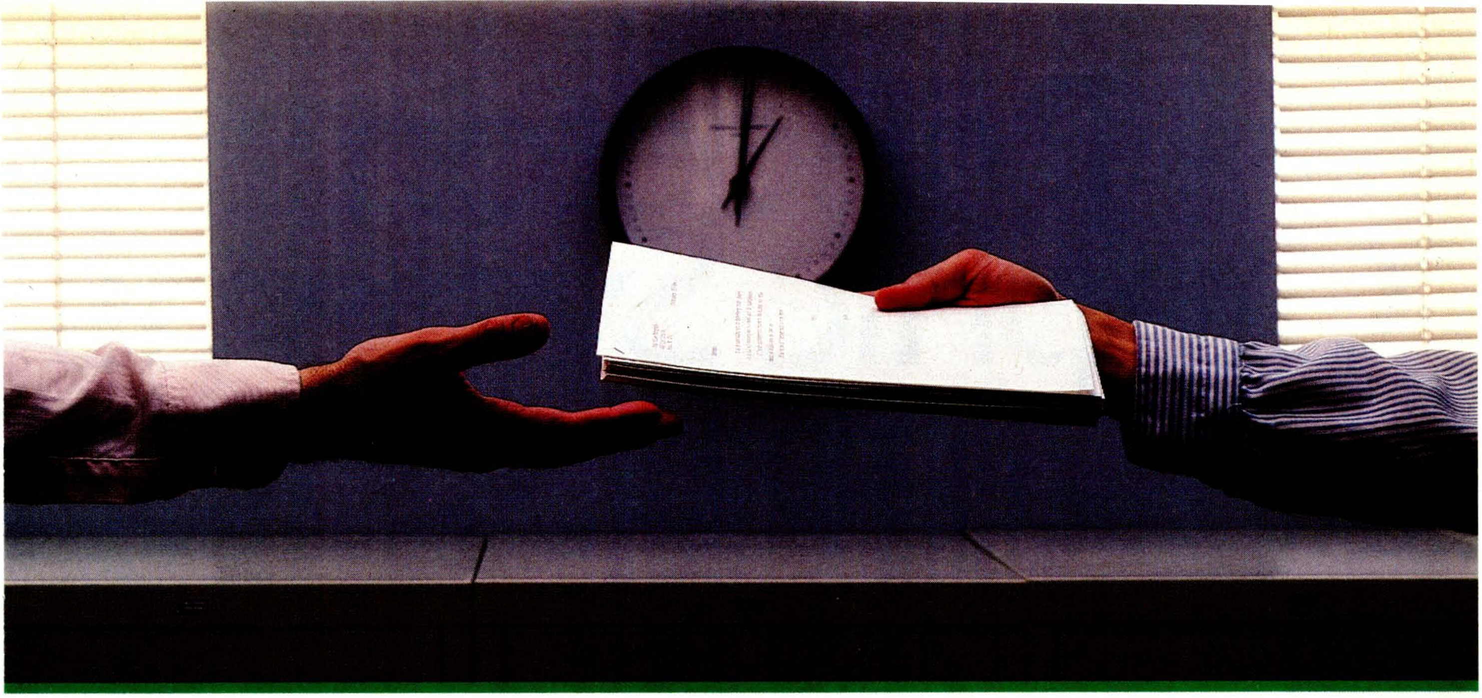
For Model 100 owners unhappy with the laptop's limited display, Axonix has the Thinview LCD panel ($699). It measures 1¼ inches thick by 6½ inches high by 11¾ inches wide. It's an 80-column by 25-line battery-operated display. The unit plugs into the RS-232C port or expansion bus socket and includes driver software that routes the normal LCD input to the Thinview. Weight, including batteries, is less than three pounds. The nicad batteries provide up to 16 hours of continuous use. The display is 640 by 200 pixels for a total of 128,000 addressable pixels. While the unit is normally set for 80 characters, you can get a compressed display of up to 106 characters per line. The Thinview has its own 16K bytes of memory for the display and has scrolling, paging, and cursor-control capability. You can even get up to 64K bytes of programmable memory in the unit.

To connect your Model 100 to the real world, there is the $549 PL-1000 from Elexor Associates. This RS-232C device has a 16-channel 12-bit analog-to-digital input, a 2-channel digital-to-analog input, 32-bit digital I/O, nonvolatile memory, and room for two additional boards in the chassis. Expansion boards currently available handle digital I/O, A/D, timer/counter, triac, optoisolator, relay, battery option, and a direct bus to the Model 100. The unit is only slightly larger than the Model 100.

Finally, if you are frustrated with hotel phone systems that don't give you access to the phone lines (no modular plugs) and don't like the low reliability of the Radio Shack acoustic couplers, the Black Jack modular jack ($49.95) adapter from Microperipheral Corp. might be just what you want. To use it, you remove the mouthpiece from the telephone, screw in the Black Jack, plug the modular cable into the Black Jack, dial your remote system, and start communicating. The Black Jack circumvents unreliable and noisy acoustic couplers and lets you transmit and receive from phones that don't use the standard modular plugs.

SUMMARY

The Model 100 has come quite a distance since its introduction. With its current low price and the number of upgrades available, the Model 100 is one of the most versatile laptop computers in the world. ■



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Inquiry 292

The IBM Proprinter

IBM's replacement for its Graphics Printer

BY RICH MALLOY

You've just printed out a three-page letter on fanfold microperforated paper. You remove the perforation strips and separate the pages. The letter looks professionally typed, but now you have to print the address on the envelope. You remove the fanfold paper and insert the envelope, being careful not to catch it on the tractor-feed sprockets. Then you print the envelope and reinsert the fanfold paper. The whole process takes about 20 minutes. You think that there has to be a better way to print envelopes. And you begin to wipe the dust off your neglected typewriter.

The new Proprinter from IBM offers a simple solution. It has a long slot on the front panel into which you can easily insert envelopes and single-sheet paper. The beauty of the design is that you never have to remove the fanfold paper.

The Proprinter has other features, too. It can print at 84 characters per second in draft mode or 27 cps in near-letter-quality (what IBM calls NLQ) mode. It is compatible with the Epson MX-80 and with IBM's previous dot-matrix Graphics Printer, and it costs a fairly reasonable $549. Unfortunately, the Proprinter is not without its problems.

At first glance, the Proprinter seems a little larger than the Epson MX-80 or FX-80. The control panel is on the left side of the front panel, which makes it easier to see. The on/off switch is on the right side, just where it is on the IBM Personal Computer. It fits attractively on a desk, but note that you will probably have to use it with some type of printer stand.

SPEED

The Proprinter is fast but, like most dot-matrix printers, not as fast as advertised. In my tests, the printer produced at an average of 84 cps, a long way from the advertised 200 cps. Actual speeds varied widely from 72 to 115 cps. By comparison, an Epson FX-80 printed at 81 cps in the same test.

In emphasized mode, the Proprinter slowed to an average of 42 cps, far from the advertised 100 cps. And in NLQ mode, the printer slowed to a moderate but respectable 27 cps, which is the closest of the three modes to its advertised speed, 40 cps.

The Proprinter could have had better results in our benchmark tests but, toward the end of each test, it paused between lines. I repeated the tests with a word-processing program (XyWrite II Plus) and had similar results. According to the optional Proprinter technical reference manual, the printer pauses for "dense patterns" because it thinks the print head is too hot. The manual suggests that you not turn the printer on and off unnecessarily, but I got similar results whether I had just turned the printer on or left it on for a day. The guide to operations, the only manual bundled with the printer, does not explain the problem. The benchmark test is fairly simple (a BASIC program that prints 50 lines of 60 *A*s each) and should not have caused any problems.

PRINT QUALITY

The Proprinter's print quality in draft and emphasized modes is almost exactly like that of the Epson MX-80. This is passable, if not aesthetically pleasing.

In NLQ mode, the printer does much better (see figure 1). The characters are distinct and the dots are indiscernible. However, I would have preferred a better typeface: I dislike the sans serif style, the square *O*, and the house-like *A*. Also, in draft and emphasized modes, the dot of the *i* is not lined up with the rest of the character. The Proprinter does let you download other characters. I did not try this feature, but it looks fairly straightforward.

NOISE

The new ink-jet, thermal-transfer, and laser printers are very quiet. The Proprinter harks back to a noisier time. It seems as loud as any dot-matrix printer I have used.

Also, because of its rather high speed, the

(continued)

Rich Malloy is BYTE's New York editor. He can be reached at BYTE/McGraw-Hill, 43rd Floor, 1221 Avenue of the Americas, New York, NY 10020.

AT A GLANCE

Name
IBM Proprinter

Type
Dot-matrix printer

Manufacturer
IBM National Distribution Division
1000 Westchester Ave.
White Plains, NY 10604
(800) 426-2468

Features
- Draft mode: 200 cps (84 cps actual)
- NLQ mode: 40 cps (27 cps actual)
- Maximum graphics resolution: 240 dots per inch
- Compatible with IBM Graphics Printer and Epson MX-80
- Front slot allows easy insertion of single-sheet paper and envelopes
- Tractor-feed and friction-feed mechanisms

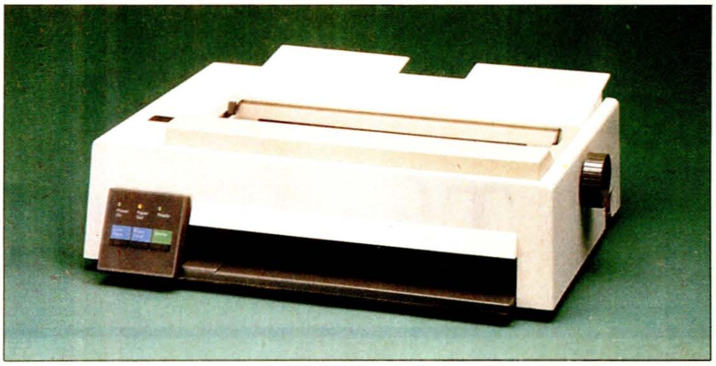
Options

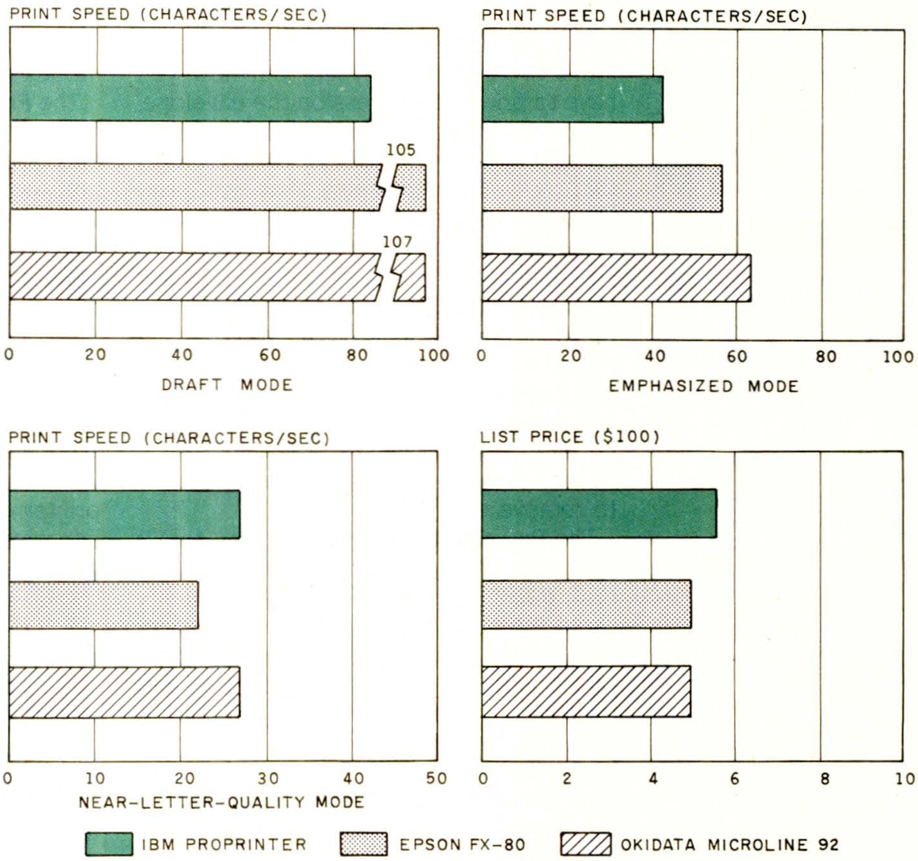
Serial interface	$99
5K-byte buffer	$35
Ribbon cartridge	$9.25
Technical reference notes	$28

Documentation
160-page guide to operations

Warranty
One year

Price
$549



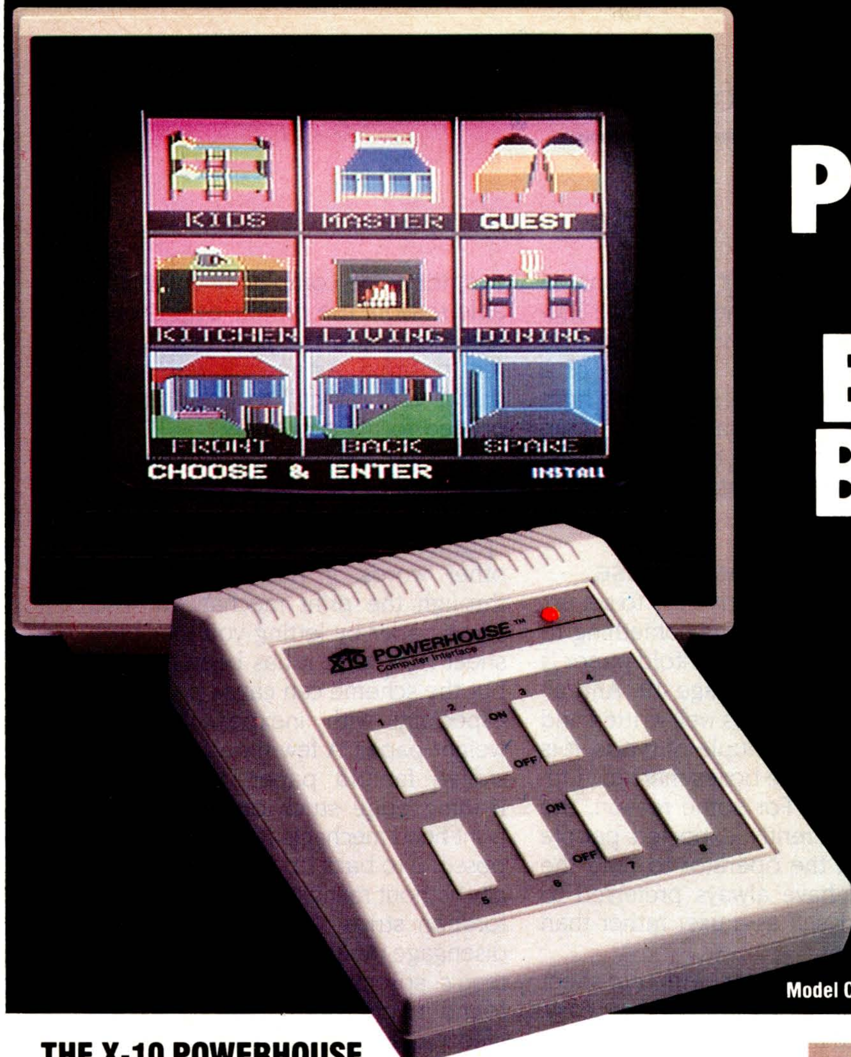


This is the IBM Proprinter, Emphasized mode

This is the Epson FX-80, draft mode.

This is the Okidata Microline 92 in draft

A comparison of the IBM Proprinter with the Epson FX-80 and the Okidata Microline 92. The pitch for all the printers is 10 characters per inch. The print speeds were determined by timing how long it took the printers to print 50 lines of 60 *A*s each. The prices shown are list prices.



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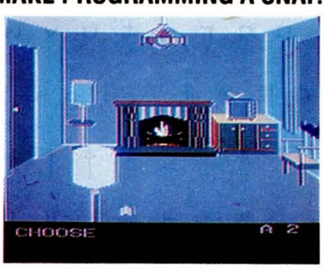
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Inquiry 379

sound it produces is up in the high-frequency end of the audio spectrum. This can be disturbing. Because of the noise, I would not recommend this printer in crowded office situations unless a soundproof enclosure is available.

COMPATIBILITY

Compatibility ensures that a large number of software packages will run on a new printer. The Proprinter is not only compatible with the graphics and accented characters used by the IBM PC, but IBM claims that it is compatible with all the software designed for the Graphics Printer. I tested XyWrite II Plus configured for an Epson printer, and it ran fine even during microjustification (i.e., justifying the right margin by inserting small spaces between each letter in a line). I also tested WordStar 3.3 without problems.

For graphics I tested Fancy Font, a software package from SoftCraft Inc. that can print a document in various type styles and is similar to MacWrite on the Macintosh. The program worked well when set up in Epson MX-80 mode but not when set up for an Epson FX-80.

I found only one major difference between the control codes of the Proprinter and those of the Epsons. In the Epson family, the sequence Esc-G causes the printer to go into double-strike mode (each dot of a character is printed twice, one right below the other). On the Proprinter, Esc-G starts the NLQ mode (see figure 2 for a demonstration of printing capabilities).

LEARNING AND EASE OF USE

The Proprinter is fairly easy to set up, but the manual leaves something to be desired. Installing fanfold paper is not explained until page 49. And although the manual is well written and contains only a couple of typos, it is littered with little boxes marked "Operator Note!" For some reason, the author apparently expected people other than the operator to read the manual. I have always preferred to think of myself as a user rather than an operator.

Using this printer with cut-sheet paper is straightforward but not easy. To advance the paper line by line, you need only insert the paper into the front slot and press the Line Feed button until you reach the desired position. However, it is hard to determine the correct print position. It is very difficult to view the part of the page where the print head is positioned and, for some completely unfathomable reason, the printer begins one-half inch below the print head's current position. As a result, you might find it very difficult to position preprinted forms accurately.

I also found it a little hard to use fanfold paper. The printer includes a tractor-feed mechanism, but it is a "pusher" rather than a "puller"; in other words, it pushes the paper through the print mechanism. This saves paper by letting you tear off a sheet right after it has been printed, but the scheme can cause problems, especially with inexpensive, lightweight paper. A few times when I installed fanfold paper, the paper's leading edge stuck on part of the print-head mechanism. It is almost impossible to back up the paper manually without mangling the paper's perforation strips, and it is difficult to disengage the paper from the tractor-feed's sprocket wheels. I therefore found it very hard to remove a mangled page from the printer.

The Proprinter lacks two features that, although missing on many printers, would make life much easier for the user. First, a prominent switch on the front panel should let you change print modes. The Proprinter

(continued)



Figure 1: *An example of the characters printed by the IBM Proprinter in NLQ mode.*

Draft: ABCDEFGHIJKLMNOPQRSTUVWXYabcdefghijklmnopqrstuvwxy01234567
Boldface: ABCDEFGHIJKLMNOPQRSTUVWXYabcdefghijklmnopqrstuvwxy01234
Underlined: ABCDEFGHIJKLMNOPQRSTUVWXYabcdefghijklmnopqrstuvwxy012
Nonprinting:
Compressed: ABCDEFGHIJKLMNOPQRSTUVWXYabcdefghijklmnopqrstuvwxy0123456789
Superscript: ABCDEFGHIJKLMNOPQRSTUVWXYabcdefghijklmnopqrstuvwxy01
Subscript: ABCDEFGHIJKLMNOPQRSTUVWXYabcdefghijklmnopqrstuvwxy0123

Special accent characters (codes 131-140): âäàåçêëèïî
(selected from character set 2)

Control Codes
Escape E: Emphasized
Escape F: Cancels Emphasized
Escape G: Double-Strike (near letter qual)
Escape H: Cancels above
Escape E & G: Emphasized Double strike
Escape F & H: Cancel emphasized double strike
Escape I ASCII 2: Near Letter Quality
Escape I ASCII 0: Normal quality
Escape S ASCII 0: Superscript
Escape T: Cancels above
Escape S ASCII 1: Subscript
Escape T: Cancels above
Escape "-" ASCII 1: Underline following text
Escape "-" ASCII 0: Cancel above
Escape ":": Start 12 characters per inch pitch
ASCII 18: Start 10 characters per inch pitch
Escape W ASCII 1: Double-wide pr
Escape W ASCII 0: Cancel double-wide printing
ASCII 15: Condensed printing
ASCII 18: Cancels above
ASCII 15 Escape E: Emphasized Condensed printing
ASCII 18 Escape F: Cancels Emphasized Condensed printing
ASCII 15 Escape G: Double strike Condensed printing
ASCII 18 Escape H: Cancels Double strike Condensed printing
Escape ":" Escape G: Start 12 characters per inch pitch, double strike
ASCII 18 Escape H: Cancel above

Figure 2: *Samples of the Proprinter's printing capabilities.*

In many ways, the IBM Proprinter seems to be a clone of the Epson FX-80.

has such a switch, but it is tiny, unlabeled, and hidden deep inside the machine. Second, you should not have to press the Online button before the Line Feed or Form Feed buttons. In order to skip to the next page on the Proprinter, you have to press Online, Form Feed, and Online again. Why not just Form Feed? Almost all printers are set up this way, and I have no idea why. In fact, the only printer I know that has both of the above features is the Texas Instruments Model 855.

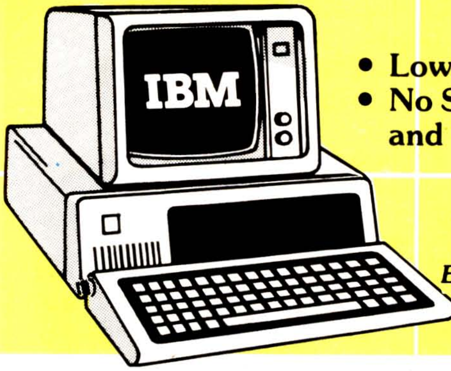
CONCLUSION

In many ways, the Proprinter seems to be a clone of the Epson FX-80. Its two distinguishing features are its NLQ mode and its slot in the front to allow easy printing on single-sheet paper and envelopes. Unfortunately, the printer has some problems handling fanfold paper, and the NLQ font could have been made more pleasing without much extra work.

The important things to consider in a dot-matrix printer are cost, print quality, speed, noise, compatibility, reliability, and ease of use. The Proprinter has a reasonable price of $549. An equivalent Epson FX-80 sells for $499. In terms of print quality, speed, noise, and compatibility, the Proprinter is unexceptional. As for reliability, it is difficult to say much after a short test; the printer seems solidly built and has a one-year warranty, but the jury is still out. The only area where the Proprinter excels is ease of use, and that only because of its front slot. If you will not be using this slot much, I suggest you look around at other dot-matrix printers. However, if you would be using this feature fairly often, I recommend this printer. ■



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OKIDATA 192	376
OKIDATA 182S	259
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EPSON FX-80 TRACTOR	371
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Panasonic's 4-Color Graphic Penwriter

It's an electronic typewriter, a printer, and a graph maker

BY JON R. EDWARDS

The Panasonic 4-Color Graphic Penwriter, a versatile electronic typewriter and graph maker, has so great a list of "stand-alone" features that it is easy to overlook the RS-232C serial interface that permits the Penwriter to function as a printer. The Penwriter has a built-in graphics package, including column layout and pie, bar, line, and radar graphs. You can easily change colors and select from among two fonts and 10 different character sizes. The list of features also includes vertical printing, a 4K-byte text-memory buffer for editing short documents, and a command mode for composing lines and figures. The printer can also access the command mode, letting you write simple programs to generate printed graphics.

The Penwriter is certainly portable. It can run on batteries, and it measures 14½ by 10½ by 2½ inches and weighs slightly less than 6 pounds (without batteries). A plastic dust cover holds additional pen sets.

The Penwriter uses water-based ballpoint pens to print. Panasonic rates the life of each pen at approximately 40,000 characters. Characters are not as well formed as they are with daisy-wheel printers, however; many of the characters have a dot-matrix appearance, but the printing method does allow a variety of fonts, character sizes, and graphics.

At first glance, the top of the unit appears daunting. The keyboard contains a number of nonstandard keys, and many switches and buttons complicate its appearance. In truth, however, I must admit that I have long disliked DIP (dual in-line package) switches; I prefer to have quick access to every option.

In the upper right-hand area of the keyboard are eight switches and a color-change button. Pressing the color button rotates the pen holder one stage through the cycle of black-red-green-blue. You can set the eight switches for interesting combinations of printing modes and character fonts, sizes, and shapes. You can, for example, choose between italics and a "normal font," select bold type or underlining, alter the horizontal or vertical size of individual characters (see figure 1), change the line spacing, select one of two available character sets, type or draw in direct mode, or set up the Penwriter as a printer.

Above the keyboard and to the left are five graphics keys (see photo 1). The column-layout function frames information within boxes. Like all the graph functions, however, it does not work in conjunction with software. Rather, you must set up the columns either in direct-printing (DP) mode or in line-by-line (LL) mode. This is perhaps the most severe limitation of the "printer," since the other charts, while able to use data from any other type of graph, are limited to 12 data entries. The appearance of the graphs is impressive (see figure 2). They are available in three sizes, with selective hatching and color, and there's a data-editing feature, but you may miss the ability to tie the functions to spreadsheets.

The keyboard contains several keys common to typewriters but not to computers. These keys handle the setting and releasing of tabs and margins. The character-set selector introduces a range of additional characters, including international symbols. Five accent symbols are designated as dead keys, facilitating their use with other characters. There is, however, no easy way to use these additional keys and features in the printer mode.

AS A TYPEWRITER

As an electronic typewriter, the Penwriter has four modes. In DP mode, it immediately prints the keys that you press. You can set the margins, use the tab, backspace to move the carriage, and use the margin release to pass the right margin. As with some typewriters, a buzzer sounds to indicate the approaching right margin. The Penwriter can center text, flush text against the right margin, and produce overlays for very distinctive printing (see figure 3).

(continued)

Jon R. Edwards is a technical editor for BYTE. He can be contacted at POB 372, Hancock, NH 03449.

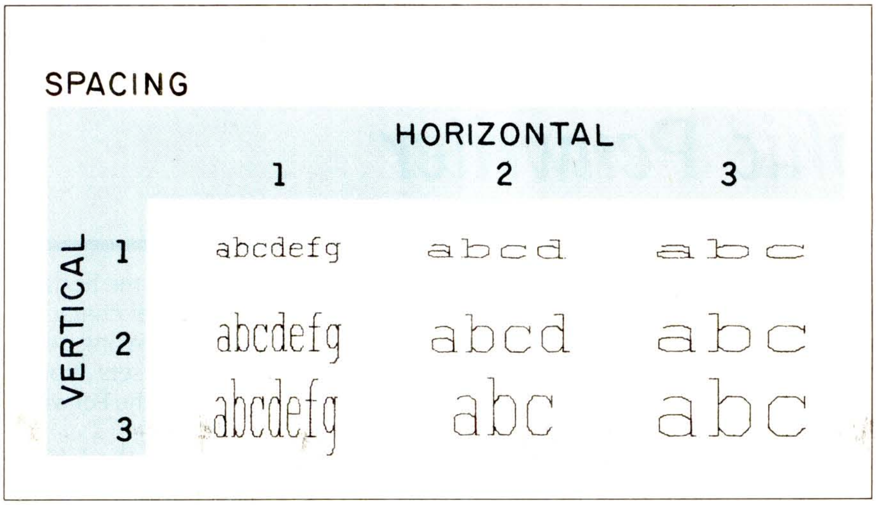


Figure 1: *Two of the switches on the Penwriter keyboard control the horizontal and vertical sizes of the characters. The standard line has about 10 characters per inch. Note that the linefeed space is proportional to the vertical size of the character. Other switches change the print color, select among boldface, underlining, and italics, set the line spacing, and put the Penwriter into its printer mode.*

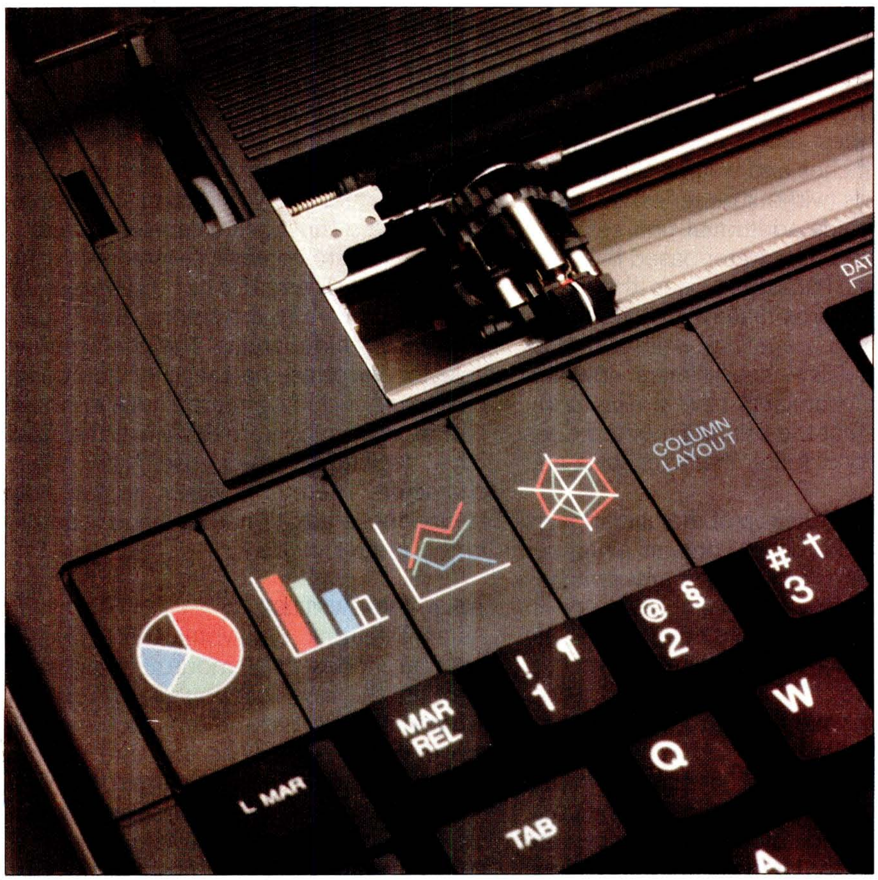


Photo 1: *The Penwriter's five graphics keys are used for pie charts, bar charts, line graphs, radar graphs, and column layout.*

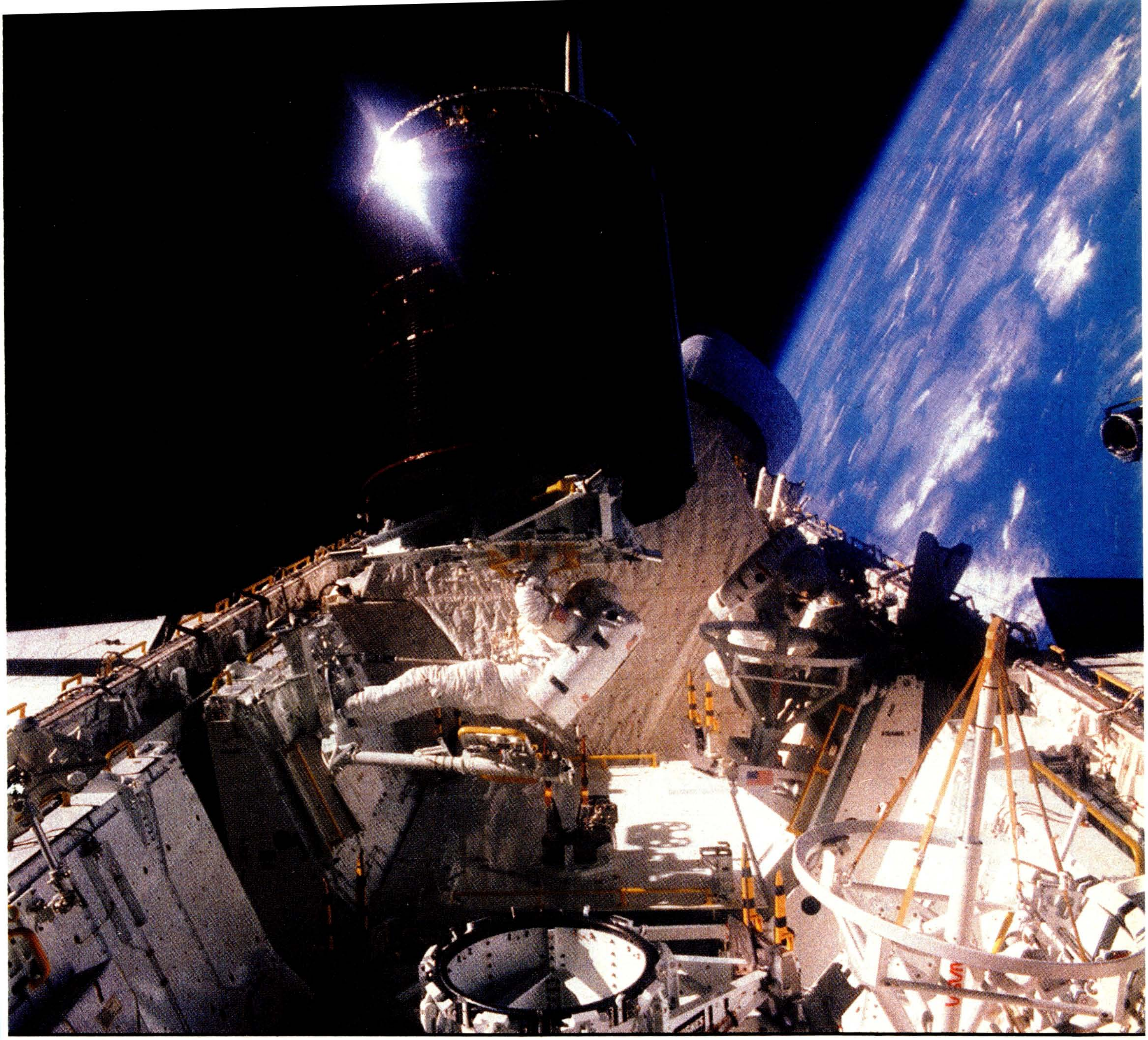
In LL mode, characters are displayed on the 24-character-wide liquid-crystal display (LCD) before they are printed. You can edit the text appearing on the screen with the Backspace or the Forward key. The Delete key erases characters under the screen cursor. You can print vertically in both modes by pressing Code and the V key. When printing vertically, the space bar and the Reverse Index, Index, Return, and Backspace keys adjust the paper, but you cannot set the top margin and tabs.

The command mode accepts and executes graphics commands. You can move the pen; establish an origin; draw lines, dashes, axes, and circles; and set the character size, color, and rotation. You can generate graphics immediately or use the printer, a method that vastly enhances the graphics potential of the Penwriter. One control code (12 hexadecimal) puts the printer into command mode. I was therefore able to use the BASIC LPRINT command to change color, draw circles, and rotate characters. Using several examples in the documentation as a guide, I wrote a short BASIC program (see listing 1) that generates figure 4. I also printed some letterheads.

Pressing the Mode In/Out key enables the fourth mode, text memory. In this mode, the Penwriter can store up to 3310 characters in its memory; you can divide the work space into nine phrase memories. Special keys print the text, search for specified words, delete the contents of a phrase, check the amount of memory available, and shift the cursor left, right, and up or down one line. You can set margins before or after entering text. There is an automatic word-wrap feature.

You can use the Penwriter with batteries or with an external AC power adapter that comes with the unit but does not neatly tuck away inside the dust cover. When the batteries are weak, the LCD begins to flash. With batteries in, or if the AC adapter is continually connected, text memory, graphics data, RS-232C transmission

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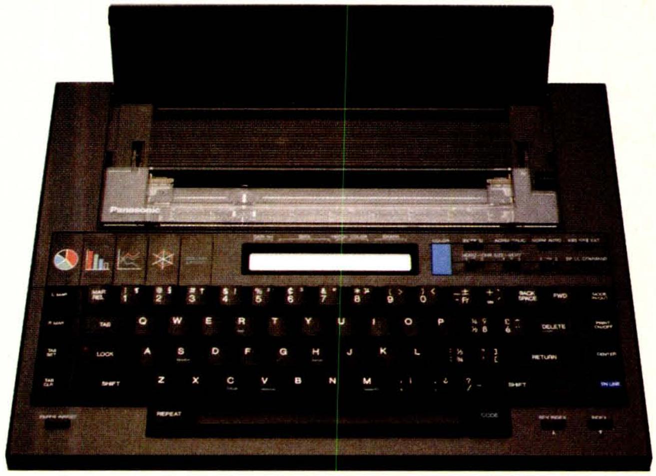
Manufacturer
Panasonic
One Panasonic Way
Secaucus, NJ 07094
(201) 348-7000

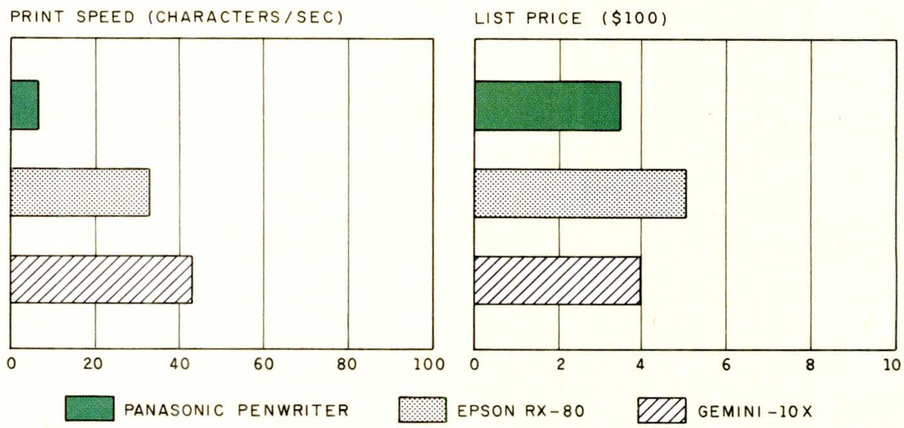
Size
14½ by 10½ by 2½ inches

Features
Four water-based ballpoint pens (each has 40,000-character capacity), 24-character LCD, five graphics packages, Courier and italic fonts, boldface, underlining, variable character size, 13 graphics commands, 4K-byte memory buffer, RS-232C interface (receive-only), battery option, 80 characters per line

Documentation
64-page user's manual

Price
$350





This is the Panasonic 4-Color Graphic Penwri

This is the Epson RX-80 in emphasized mod

This is the Star Gemini-10X This is the St

The Panasonic 4-Color Graphic Penwriter is compared with the Epson RX-80 and the Star Micronics Gemini 10-X in emphasized mode. The pitch for all printers is 10 characters per inch. The print speeds were determined by timing how long it took the machines to print the Shannon test (573 characters; see "The Art of Benchmarking Printers" by Sergio Mello-Grand in the February 1984 BYTE, page 193). The prices shown are list prices.

format, margins, and tab-setting positions remain in memory. As an extra feature for forgetful battery users, the Penwriter automatically switches off (without harming text memory, etc.) when there has been no input for about 10 minutes. This does not apply when you use the Penwriter as a printer.

Loading paper is a relatively straightforward procedure. Insert the paper into the paper channel, press the Insert key, and the paper moves forward automatically. I miss not having a platen knob to move the paper, however, and I found the paper-release lever, which must be released to adjust the paper, flimsy and far too tiny. It is almost impossible to insert the paper manually by releasing the lever and maneuvering the paper through; you must follow the directions.

The sheet feeder is not intended for continuous paper, and there is no optional tractor-feed mechanism. It would not be easy to use continuous paper. And in ordinary use, metal paper guides that press against the platen tend to perforate the left and right edges of even the thickest paper, distracting from the otherwise fine appearance of the printed output.

AS A PRINTER

I hooked the printer to the serial port of an IBM Personal Computer. Before going on line, the printer can accept new values for transmission rate, data length, and automatic linefeed. Once set, the values become defaults. You can also set the switches for color, boldface, underlining, italics, and character size. Alternatively, you can use underlining, boldface, and italics by calling upon the appropriate escape functions cited in the manual. Panasonic claims a printing speed for the Penwriter of 6.5 characters per second (cps). However, using the Shannon test (see "The Art of Benchmarking Printers" by Sergio Mello-Grand in the February 1984 BYTE, page 193), I recorded the speed at 5.7 cps. Printing in boldface or with larger characters visibly slows the machine.

(continued)

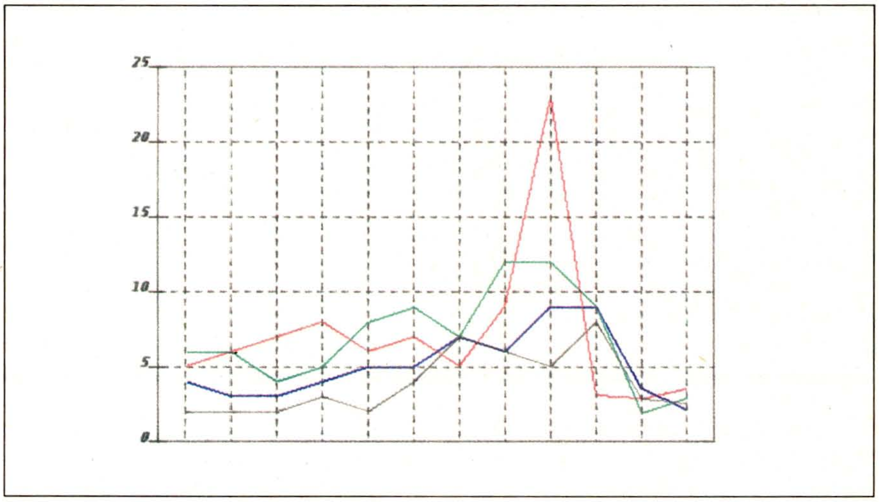


Figure 2: *A comparative line graph.*

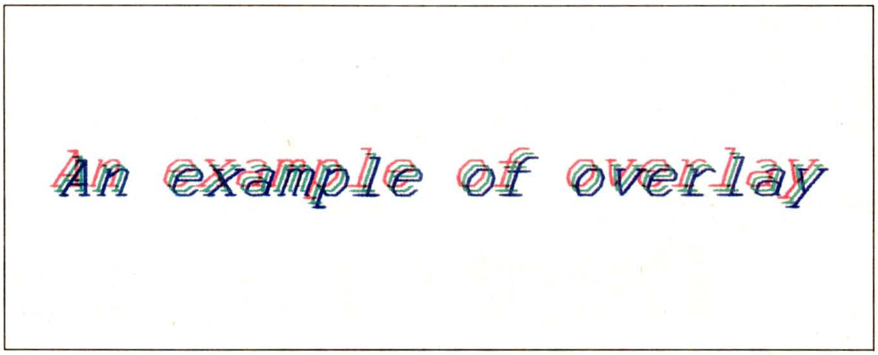


Figure 3: *The Penwriter supports overlay printing in its direct-printing mode.*

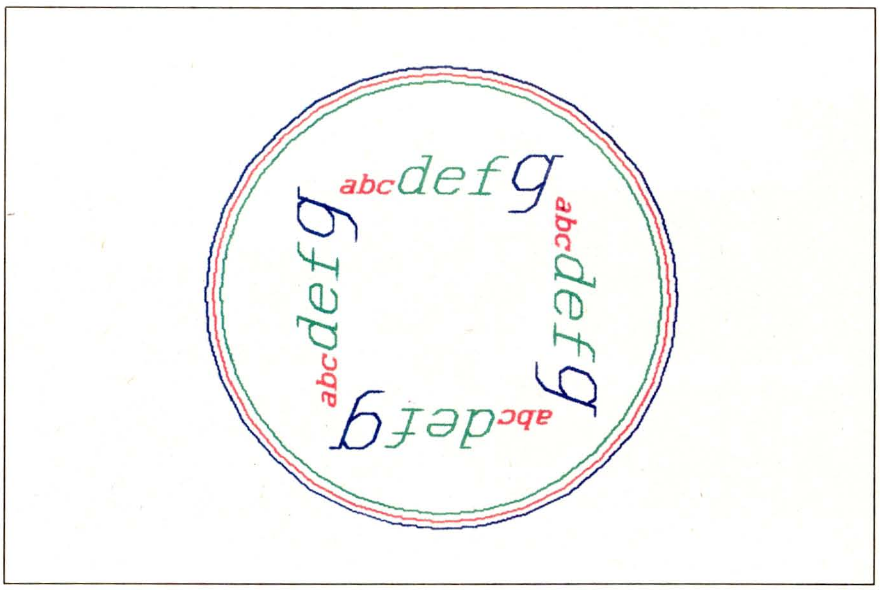


Figure 4: *An example of Penwriter graphics.*

Listing 1: *This program uses the printer in command mode to produce figure 4.*

```
10 LPRINT CHR$(18):REM enter command mode
20 LPRINT "r500,0:i":REM initialize origin
30 LPRINT "c3:y150:c2:y145:c1:y140":REM draw circles
35 LPRINT "r-75,75":REM relative move from origin
40 FOR X=0 TO 3
50 LPRINT "q";X:REM print in four directions
60 LPRINT "c1:s1,1:pabc"
70 LPRINT "c2:s2,2:pdef"
80 LPRINT "c3:s3,3:pg"
90 NEXT X
```

I recorded the slowest operation, boldface printing of characters three times the standard width and height, at 0.8 cps.

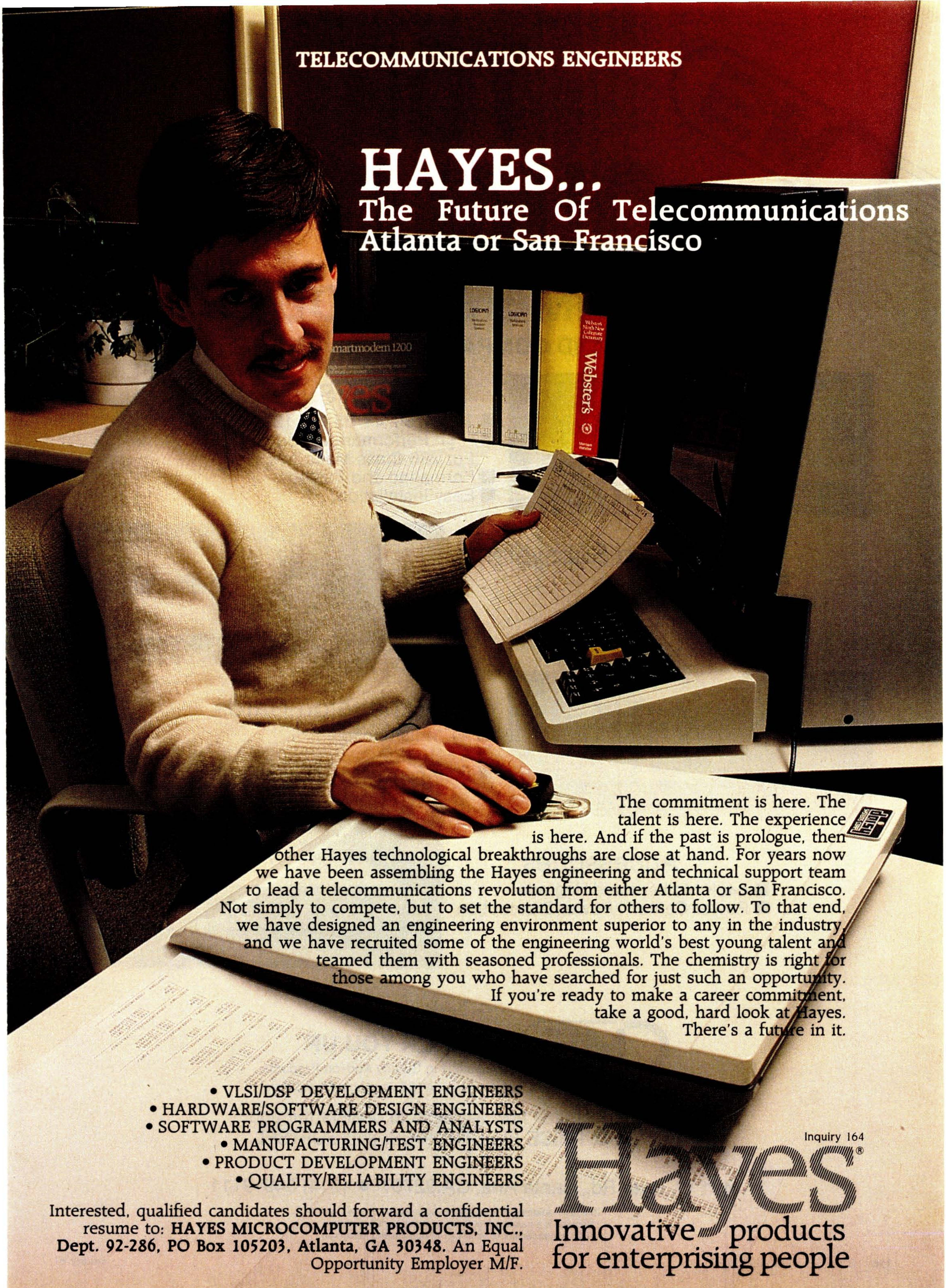
Cables are available to connect the printer to a serial port on an IBM PC, to the superserial card on the Apple, to the VIC1011A on a Commodore, or to the built-in serial port of the Panasonic Sr. Partner RL-H7000. There is no optional parallel port. The RS-232C port is receive-only; you cannot use the Penwriter as a dumb terminal. Unfortunately, there is no provision to use the 4K-byte buffer as a spooler.

Documentation

The manual is excellent. Careful, diagramed instructions cover every aspect of use. There are instructions for replacing batteries and pens and for inserting paper; the manual explains every special key, switch, and printing mode. A section on use as a printer includes pen assignments and control codes.

Summary

I enjoyed working with the 4-Color Graphic Penwriter. It combines versatility with a good price, though I remain concerned that some of the plastic components, including the paper guide and the transparent cover over the carriage, are too fragile to hold up under heavy use. I was also distracted by the perforation of the margins. Still, the Penwriter is a good value for people who require its versatility: One moment it's a printer, the next an electric typewriter with memory, and then a fancy printer of graphs and graphics. ■


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OSBORNE 3

I'd like to bring up some features of the Osborne 3 computer not covered by Donna Osgood in her review (September, page 284) and to emphasize others that I feel were covered too briefly. I have owned my Osborne 3 for seven months and have explored many of its limitations and advantages.

I wanted a machine that could support compilers for all the current languages, which meant I needed MS-DOS. I also craved the background print spooler and easy 1200-bps modem support. IBM media compatibility was a feature I desired so I could borrow one of the PC ATs at work for my large jobs. Above all, I wanted to avoid planned obsolescence. Portability was indicated, so I also put battery operation on the wish list. The Osborne 3 was the only machine on the market that met a majority of the criteria on my list.

I purchased my machine with 512K bytes of RAM, a nicad battery, and some free software my dealer threw in. The disk drives are very slow due largely to the lack of a track-zero detector on the Panasonic drives used in the machine; this necessitates a lot of grinding during disk access. So the first piece of software I obtained was a RAM-disk utility—end of that problem.

As I dislike editors that use the screen for anything but text, I haven't experienced the difficulty Osgood discussed in her article. She did neglect to mention the Osborne's auto-cursor mode. In this mode, the 24-line logical screen is auto-scrolled onto the 16-line Osborne LCD so the cursor is always visible. The fast repeat speed of the keys makes it easy to zip the cursor about to see any part of the screen.

Possibly the most unique feature of this machine does not appear in any manual. Since the Osborne runs on any voltage between 12 and 15 volts, I bought a power connector to match the Osborne's, a cigarette lighter plug, and 20 feet of heavy-gauge wire. I can compute anywhere I can drive my car without depleting the Osborne's on-board battery.

Osgood properly emphasized the limitations of the Osborne LCD. While vastly better than the Data General/One or Kaypro 2000 displays, the contrast is still weak in normal room lighting. This is readily improved with strong over-the-shoulder lighting. The contrast is then entirely acceptable, and I have experienced no eyestrain after lengthy sessions at the machine.

I can easily carry my entire setup in a tote bag, including a tub of 50 disks. My projects on the machine include a quick-and-dirty database program written in Prolog for my Naval Reserve unit, a full relational database system with query language written in C, a set of MS-DOS utilities in C, and the design of an EMACS-like editor system to be written in either muLISP or IQLISP. When Turbo Pascal arrives, I'll probably finish some of the projects left over from my p-System Apple.

Last of all, I'd like to address the inevitable questions about the superiority of the Morrow Pivot and Zenith machines. They are better; for more than double the price, they had better be. And they certainly are not anywhere near double the machine.

ROBERT W. CUNNINGHAM
San Diego, CA

PARADISE CARD

I am writing in response to Harry Krause's review of the Paradise Modular Graphics Card (September, page 321). We use the card on IBM PCs with Princeton Graphic Systems MAX-12 amber monitors. We are unable to run programs such as DisplayWrite 2 that default to color mode when a color card is used. Although we turn the contrast and brightness knobs to full intensity, many of the shades representing colors are too dim to be easily read. The MAX-12 has no internal adjustment for intensity. We do not have this problem on IBM monochrome monitors because they have sufficient brightness control to make all shades easily readable.

We have tried using the MODE BW command at the operating-system level prior to running the application programs. This does not solve the problem because it seems that the MODE command operates only on the composite signal produced by the color card, not the RGB signal.

We welcome suggestions from readers on how to solve the problem. Unless a solution is found, I suggest that users considering purchasing the Paradise Modular Graphics Card first test the card on their systems, using a program that produces text in several colors.

JAY FRANCIS
Colorado Springs, CO

JUKI 6100

In response to David Lewiston's letter on the Juki 6100 (August, page 286), I would like to say that I have been using a Juki 6100 for over a year now. The printer has seen fairly heavy use. My setup includes a tractor feed. I have not had the problems that Lewiston describes.

I do have some suggestions based on experience. For the sticking ribbon problem, the only IBM-style ribbons that don't stick are the pink-leader single-strike filament ribbons. The orange-leader ribbons and blue-leader multistrike correctable carbon-film ribbons jam within 8 to 10 pages. While the yellow-leader ribbons don't jam quite that fast, they do shed, so you get tiny black specks all over the paper while the letters fall off the page. I've heard reports that the noncorrecting blue-leader multistrike fabric ribbons also work, but I don't know that from my own experience.

I've run into the take-up problem to an extent. The solution seems to be to wind the ribbon up to the point where the colored leader has gone into the cartridge. Sometimes it does hang up if the leader isn't all the way inside the reel. (Of course, using a ribbon that tends to jam anyway would exacerbate this.)

I don't know what to say about the irregular spacing or the crooked lines. I suggest checking the software for the spacing problem. I had some weird results until I edited my word processor's printer driver a bit. For the slanting lines, try clamping the paper onto the back of the tractor-drive unit as well as the front.

JAMES D. MACDONALD
Miami, FL■

REVIEW FEEDBACK *is a column of readers' letters. We welcome responses that support or challenge* BYTE *reviews. Send letters to Review Feedback,* BYTE *Publications,* POB 372, Hancock, NH 03449. *Name and address must be on all letters.*



Kernel

JERRY AND HIS WIFE recently left Chaos Manor to take a trip to Europe. It proved to be a working vacation because he visited locations to be found in his next novel. But he didn't entirely forget computers, being able to spend a few days at the Swiss Federal Institute of Technology—one of the important centers of the computer revolution. This month's column describes some of the projects taking place there.

In BYTE U.K., Dick describes the new Torch Triple X—a low-cost personal computer that runs UNIX System V and is driven by Motorola's 68010. Dick claims that the Torch Triple X is aimed at the AT&T market (although the Torch is priced lower), but Dick believes Torch may get its most serious competition from Commodore's Amiga.

In July Bill Raike visited Taiwan, where he attended the Computex '85 computer show and checked out the software piracy problem in that country. In this month's BYTE Japan column he discusses several of the products he saw at the show; most of them are IBM PC, PC XT, or PC AT clones. He also describes a pirate software shop he found in Taiwan.

Bruce Webster's column deals almost entirely with the subject of color graphics on microcomputers. He gives a brief survey of the field, describing the graphics systems on some of the popular computers. This includes his opinion on whether or not Apple should come out with a color Macintosh.

MICROSOFT.
PRESS

The Classic Returns.

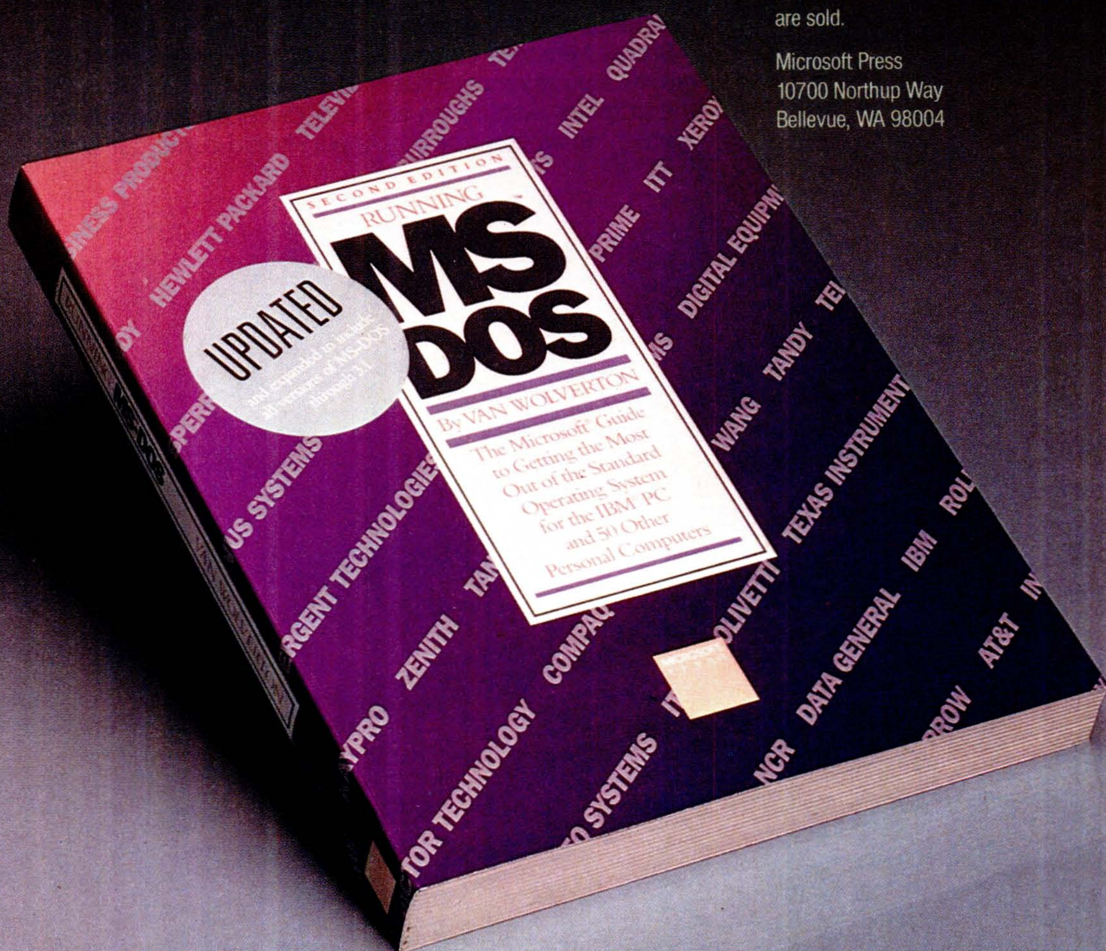
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The European Connection

ETH
Lilith
Modems
Percy
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Purple Computing
Terminals

BY JERRY POURNELLE

I'm starting this in Graz, a city I never even heard of until a few weeks ago. It's in the Steiermark district of southern Austria and is the location of AIMS, the American Institute of Musical Studies. AIMS is a nonprofit organization operating out of Dallas, Texas, that trains American singers for careers in European opera houses, and a very good job it does. My next novel involves intrigue, high tech, and an American coloratura soprano, so this is a working vacation.

We drove in driving rains to Graz from Liechtenstein, a country no one but stamp collectors knew about until a few years ago. It is now a center of high-tech enterprises and, incidentally, the third or fourth wealthiest country per capita in the world: a great location for parts of my novel. The rainstorm, it turned out, was one of the worst they'd had in 20 years. It washed out many of the roads we wanted to take, as well as flooding much of Innsbruck and Salzburg. Getting to Graz was an adventure in itself. After Graz we go to Vienna, then Salzburg, then on a general tour of the Tirol.

If all this sounds like I didn't do much computing at Chaos Manor this month, you're right; even so, there's plenty to report. As part of our travels, I managed to spend a couple of days in Zurich, Switzerland, at the Eidgenossische Technische Hochschule, otherwise known as ETH, the Swiss Federal Institute of Technology. Hochschule sounds like "high school," but don't let that fool you. Einstein taught at ETH; it corresponds closely to MIT or Caltech. Like MIT, ETH has a number of departments. The one of particular interest to me is the Institut fur Informatik, where Professor Niklaus Wirth invented both Pascal and Modula-2.

We were fortunate to be at ETH with Dr. Richard Ohran, whom I've mentioned before in this column. Richard is a former member of the faculty at ETH who now runs the Modula Research Institute, a nonprofit organization founded to help ETH Informatik distribute programs and other public-domain technologies developed by the faculty and students. He also heads the Modula Corporation, a for-profit company that sells a really excellent Modula-2 compiler for the Macintosh. The Modula-2 *language* is in the public domain, as are most ETH research results; but particular *implementations* of ETH's work, including Modula-2, are developed and sold by private companies. Ohran's Modula Corporation also manufactures the Lilith computer.

Richard is a good man to have with you on a visit to ETH. Not only did he get his doctorate (with a silver medal) there, but in his earlier stay he was the hardware member of the team that designed the Lilith; now his Modula Corporation in Utah makes all the Liliths used at ETH. They have about 100 of them and want more.

The Lilith is an interesting machine. It was designed to "speak" Modula-2 and use the Modula operating system. This works better than I would have believed. The Lilith compiles and executes Modula-2 programs faster than most machines can run assembly language. The Modula-2 team designed the Lilith that way. The result is unique among higher-level languages: programmers using the Lilith can produce hundreds of lines of bug-free Modula-2 code, corresponding to thousands of lines of assembly-language code, in astonishingly short times. If Modula-2 becomes as important a computer language as I think it will, there should be considerable interest in the Lilith; it's hard to conceive of a better system for developing Modula-2 programs.

Up to now, use of the Lilith has been confined largely to Modula-2 enthusiasts and people at ETH. Not many have been manufactured, and they've been thought too costly for most software developers.

That view may be mistaken. If you intend to write really large programs so that a number of programmers have to work to-

(continued)

Jerry Pournelle holds a doctorate in psychology and is a science-fiction writer who also earns a comfortable living writing about computers present and future.

gether, Modula-2 may well be the language of choice. It's structured to make it simple to interface a number of programmer efforts with minimum problems; and the Lilith is a nearly ideal programming tool for producing Modula-2 code.

Ohran's Modula Corporation is going to make it easier to get a Lilith. About the time you read this, it intends to market a version of the Lilith that will work in conjunction with an IBM PC, using the PC's disks, keyboard, and screen. I haven't seen that work yet. I have had a Lilith off and on for more than a year, and it's one of the best software-development tools I've ever had access to. I can write Modula-2 code with the Lilith, then transfer it to the PC by recompiling with the Logitech compiler; the result works fine unless I've used the Lilith's special display capability.

For quick-and-dirty programs, I still use Digital Research's Compiling CBASIC because it's transportable across 8- and 16-bit machines, and I have a pretty good library of CBASIC routines; but I suspect that one day I will convert all my CBASIC stuff to Modula-2. It's not that hard to do. CBASIC is a well-structured language, particularly if you use the "declare" toggle that tells the compiler to treat an undeclared variable as an error. A couple of years ago I'd have thought anyone who deliberately required declaring all variables before using them was crazy, and I probably even said something that silly in print. Ah well, live and learn.

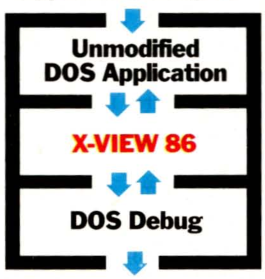
Anyway, I'm hoping that coupling a Lilith system with a PC will make both the Lilith and Modula-2 more widespread and available. ETH has developed some really interesting programs for the Lilith. As I've said before, we won't see software prices really tumble until *lots* of people have good programming environments to work in, and there are as many people trying to write big programs as there are would-be authors of books. Getting the Lilith plus the ETH development approach plus Modula-2 into the hands of U.S. hackers may have a

(continued)

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The Modula system is harder to learn than Macintosh's, but easier to use once you've learned it.

spectacular effect on the computer revolution.

32016 SYSTEMS

Another ETH project under Niklaus Wirth's direction is porting the Modula operating system (which the Lilith runs directly) over to computers using the National Semiconductor 32016 chip. The Modula operating system has a number of similarities to the Macintosh system. (No coincidence: both grew out of Alan Kay's work at Xerox. Some time ago, Wirth spent a year's sabbatical at Xerox's Palo Alto Research Center, and he was there again this summer.) The Modula system is somewhat harder to learn than Macintosh's, but in my judgment a lot easier to use once you've learned it. Anyway, ETH has a working experimental Modula system for a 32016 computer.

The 32016 runs at 10 megahertz (MHz), compared to the 6-MHz chips in the Lilith. Hans Eberle, Wirth's assistant for this project, said that he was "surprised that the 32016 is only slightly less fast than the Lilith."

I raised an eyebrow at this. Later, while having dinner with Dr. Ohran, I asked him how this could be. After all, the 32016 runs almost as fast as the 2901 chips in the Lilith.

According to Ohran, it's a matter of design philosophy. The Lilith was intended to run Modula-2. Other computers have to worry about underflow and overflow. There are no such error checks in the Lilith, just as there are no checks for stack overflow. Not only does the Lilith run Modula-2, *it runs nothing else*; there is no assembler, or, put another way, the Modula-2 compiler *is* the Lilith's assembler. Overflow and stack-explosion checks have been shifted to the compiler so that programmers need not keep track of such administrivia.

Moreover, the Lilith's 2901 chip has an obscure data path that gives I/O (input/output) operations direct access to the stack without going through the ALU (arithmetic logic unit). The Lilith fetches instructions about five times faster than any other machine. The result is amazing speed. According to Ohran, since all machines have to fetch instructions, the others have to achieve nearly an order of magnitude speed improvement just to keep up with the Lilith.

I suppose I believe this, but I have no way of checking it out. Steve Ciarcia "speaks solder"; hardware's not my specialty. I do know that I've seen the Lilith do amazing things at blinding speeds, and everyone at ETH prefers the Lilith to just about anything else. Undergraduates in the Institut fur Informatik begin with the Apple II and Macintosh; they graduate to the Lilith when they have significant project work to do. There are also VAXes and other minicomputers and mainframe machines at ETH; but the Lilith is everyone's favorite.

Anyway, the 32016 machine running Modula-2 is almost as fast as the Lilith and has better graphics control. They're now building a color Lilith around the 32016.

SOME STANDARD PROBLEMS

ETH is big on both classics and acronyms: the new 32016 machine will be known as CERES, which stands for "computing engine for research, engineering and science." The bus structure is, according to Eberle, "close to the 32016 and not standard. We need a bus that supports the architecture of the processor. Industry must worry about standards. It is not the concern of ETH."

This pretty well echoes Professor Wirth's often-expressed attitude. ETH has a dual-purpose mission, to work at the frontiers of knowledge and to train students to understand the latest developments in technology. Wirth's view is that ETH cannot become distracted by the requirement to make its technological achievements conform to industry's needs. It is enough that ETH develop generic technologies; industry must do the rest.

I can understand this view, and I even agree that academics shouldn't need to do industry's work; but sometimes the results are less than optimum. In the long run, the best technology generally wins out. In the short run, though, there can be unfortunate results: witness the proliferation of Pascal dialects and the delays in developing really practical implementations of Modula-2. I'm impressed with what ETH has done with Modula-2 and the Lilith, and I'm in a hurry to see these concepts take their rightful place in the computer revolution.

The good news is that methods for disseminating new developments at ETH are being perfected, such as Wirth's new one-pass Modula-2 compiler that compiles itself in less than five minutes. In the future, it shouldn't take so long to get new developments out of the ivory tower—actually it's granite, but you get the idea—and into the hands of users.

Modula-2 is catching on. Philippe Kahn, whose Turbo Pascal has become something of a standard—they even use it at ETH, where one medical database program for the IBM PC is 3000 lines of Turbo Pascal—has promised Turbo Modula-2 for the PC Real Soon Now, and that should help get some of ETH's programs out to BYTE readers. There are good Modula-2 compilers and Modula operating systems for the Stride family of 68000-based computers. Modula Corporation has MacModula-2. It can't be long before U.S. hackers get some of ETH's marvels in shape for the rest of us.

MUSIC AND GO

Most technical institutes require a senior thesis project for graduation. At ETH this can result in significant programs. I didn't have time to look at all of the ETH projects—most of the students weren't there anyway, it be-

(continued)

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ing summer—but Hans Hinterberger, the Informatik administrator, arranged for me to see some fascinating ones.

The first was a system in which you can play a musical piece on a standard-keyboard music synthesizer, hearing it as you play it, and then get a written transcription in musical notation. The program also separates voices and does transpositions, which are often necessary but very tedious musical chores. All this appears on the Lilith's screen; then you can use the mouse to change the notes, move things around, and otherwise fuss with the score, after which the final result comes out as hard copy from a laser printer.

This program hasn't been perfected, but it will be published when it's done; the source code should be available from the Modula Research Institute sometime in 1986. I hope U.S. hackers will pick it up where the ETH faculty and students leave it because there's a crying need for computer assistance for composers.

My friend Robert Bloch (he's often introduced as RobertBlochauthorof-*Psycho*, all one word) has the rights to do an opera based on *The Phantom of the Opera*. We have introduced him to Dr. Robert Challs, professor of music at Cal State Northridge and composer of *The Thirteen Clocks*, based on James Thurber's modern classic. By me Challs is pretty good; I generally can't stand modern opera, but I like *The Thirteen Clocks*. Anyway, we're hoping that Bloch and Challs can do *Phantom* together. Alas, the expenses of simply getting an opera onto paper, separated into parts with copies for singers and orchestra and conductor, can be staggering. Computers make a writer's life much easier by taking much of the work and expense out of producing manuscripts; I'm sure the little beasts will have just as profound an effect in the music field.

Another project that fascinates me is a program to help people who play go. Go is a game with only three rules; you can learn it in five minutes. Playing it *well*, on the other hand, can take a lifetime; it's much more complex than chess.

There is no program that can play a passable game of go. Even mediocre human players invariably win unless the computer is given an enormous handicap. The Japanese hope to produce a go program as part of the Fifth Generation Computer Project, but no one has seen any results yet.

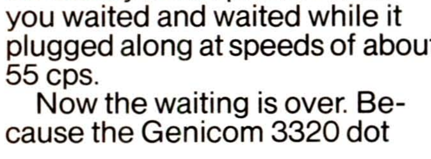
Winning at go requires an appreciation of grand strategy, and the relationships between widely separated activities on the go board are far too subtle to be reduced to rules. How-

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ever, no matter how good you are at go strategy, you must also master the game's tactics, which aren't easy. Mastering them can be tedious. Fortunately, those *can* be reduced to rules that a computer can learn.

At ETH, Anders Kierulf and Jurg Nievergelt have developed what they call a smart go board that has many ways to help go players. It can play *joseki*, which are tactical openings played in one corner. It can analyze certain tactical situations, including *ladders*. Best of all, it can record an entire game as played; then in the replay allow you to do variations and return to the actual position after you investigate alternatives to the real moves. Go has dozens of pieces, all just alike, scattered across the board. The exact position of each and the exact sequence of play are usually critical to the outcome of the game; thus, recording and replaying classic games has always involved a lot of tedious bookkeeping. That capability alone makes the ETH smart go board important.

Both the music and go programs are written in Modula-2. They're designed for the Lilith. I don't know how hard it will be to recompile them for the PC or Macintosh. Anyway, it's pretty certain that Ohran will have versions for his PC-Lilith combination when it comes out.

Music lovers and go players unite: you have nothing to lose but some drudge work . . .

DATABASES

I had a busy time at ETH; after watching the go program (and getting a promise that I'll have a copy for my Lilith Real Soon Now), I met Andreas Diener, a graduate assistant in the group headed by Professor Carl August Zehnder. They have been investigating the implications of having databases available at workstations and developing software that allows selective access and security. For example, you cannot allow casual users access to personnel data; but you might want them to be able to get statistical information about all

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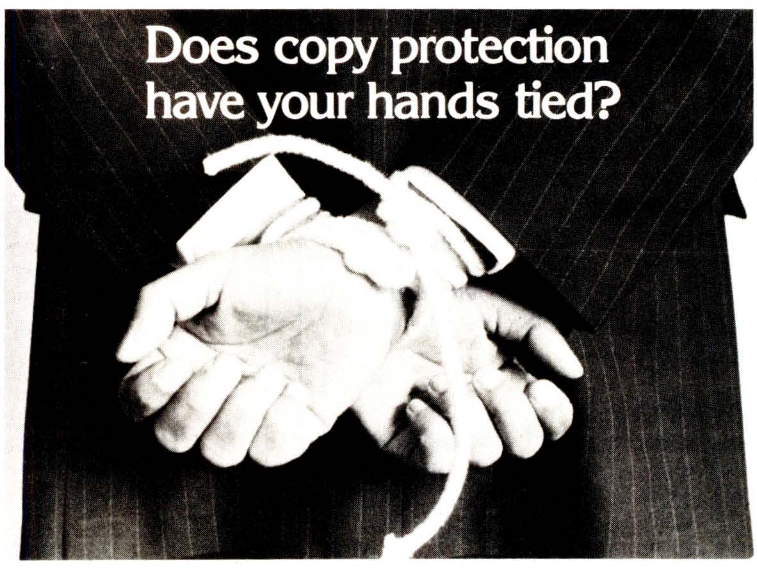
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employees. Of course, a sufficiently clever hacker may be able to ask questions that look as if they're asking for collective data but that actually apply to only one employee, so you want your system to defeat those attempts also.

Zehnder's group has recently released LIDAS (Lilith database system), which includes Modula-R, a database-language extension of Modula-2. The idea is to come up with something compatible with the Lilith and the Modula-2 compiler but adapted to database problems.

One of Wirth's least-known books is also one of his best: it has the unlikely title *Data Structures + Algorithms = Programs*. The database-programming work at ETH reminded me of that book; probably no coincidence.

Part of Diener's Ph.D. thesis is work on GAMBIT (I *told* you they're big on acronyms), a database-definition tool. LIDAS and GAMBIT are "completed but not exactly commercial," meaning that in keeping with their general philosophy, ETH declines to take responsibility for making these remarkable tools available to the average user; you can get them from ETH for a nominal fee, but it will be some commercial developer's task to reduce them to a publishable package.

I'm sure that will happen. What I saw at ETH was impressive. Here are a bunch of networked machines with what appears to be a common database. Nonprivileged users can work with the database, adding to it and getting information from it, and never even suspect that there are layers of information to which they don't have access. Moreover, you can keep private files whose existence is unknown to other users. The idea is to present private and shared data in an integrated way; and what ETH has done so far beats anything I've ever seen for either micros or minis.

Much of the work at ETH is done in English (even though English is not one of the four official Swiss languages), and Diener's thesis will be written in English and will eventually

(continued)

be available with source code through the Modula Research Institute.

AND YET MORE

There's a lot more happening at ETH. Jurg Nievergelt, Andrea Ventura, and Hans Hinterberger have done some excellent work on using computers to aid in computer science education. Carlo Muller's diploma thesis was Modula-Prolog. Others have cooperated to make it a nearly complete Prolog interpreter (see the theme section of the August BYTE beginning on page 148 for discussions of Prolog), which is written in Modula-2 and is now available for the Lilith, VAXes, and MS-DOS machines. Work on databases, networking, graphics, and man-machine interfacing continues. ETH is one of the important centers of the computer revolution, and we'll continue to hear lots more about it.

MODEM TROUBLES

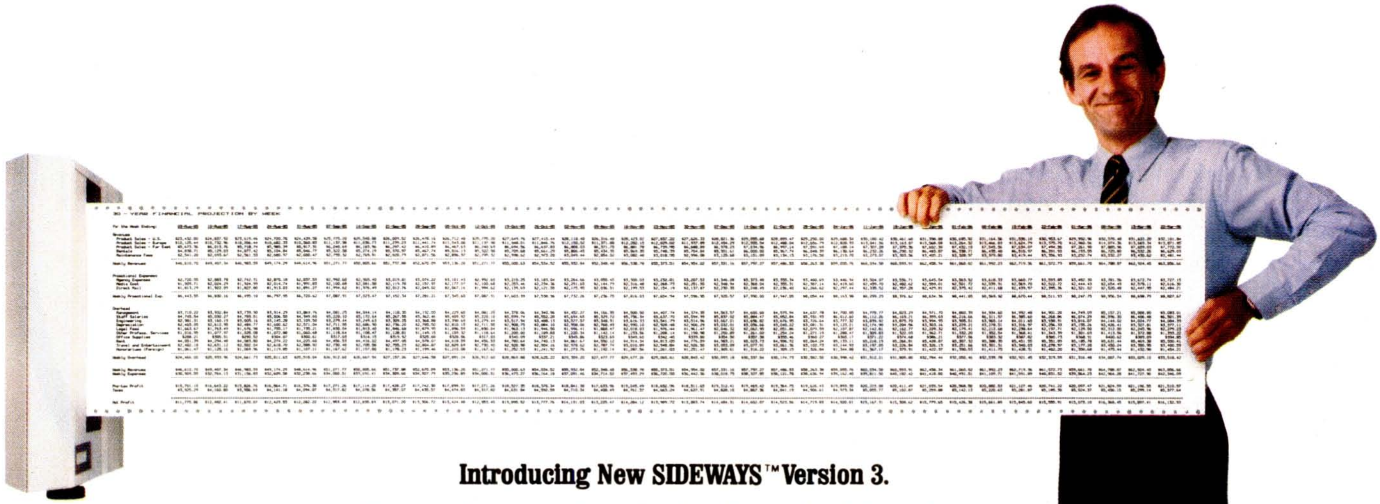
I've become addicted to the BYTE Information Exchange, otherwise known as BIX; the thought of a month in Europe without a single BIX fix was upsetting. In my last week back home at Chaos Manor, I tried a number of approaches to ensure overseas communications. Alas, they all came to naught.

Europeans do things differently from the way we do. In the U.S., we operate on credit. Tymnet, for example, is billed to the number you make contact with; the center you reach then bills you, generally through a credit card. In Europe, though, you have to pay in advance. Many post offices in Europe have facilities for connecting you to a European Tymnet gate. You go to the post office, pay your money, and are put into a small booth to use the network; then you get back anything you've overpaid.

Alas, most European networks operate at 300 baud—and Europe's 300-baud modems are not compatible with American modems. Your Tandy Model 100, or the little outside modem that attaches to the NEC PC-8201, won't work through European telephones. You *can*, I am told,

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rent a Tandy Model 100 that will chew European current and communicate at 300 baud, but so far we haven't been anywhere I could do that.

European 1200-baud systems are the same as ours; and it is possible to connect to a U.S. 1200-baud modem by a direct call to the U.S. Alas, that too has its problems. For one thing, you generally want to go to the post office to make the call. European hotels routinely add about a 400-percent surcharge to overseas calls. (In Vienna, two calls to BYTE and one to California came to $87 U.S., and they weren't long calls.)

Worse, though, is finding a portable computer with a 1200-baud modem. For some time now I have carried Percy, the NEC PC-8201, on most of my trips, and I've become very fond of him; but there is no 1200-baud modem for Percy. At NCC in Chicago this year, I met some NEC officials who were greatly cooperative about getting me one of the NEC PC-8401 Starlet machines. Starlet comes with an internal 300-baud modem, and there is an external 1200-baud modem available. Alas, the 1200-baud modem does not run on batteries! You have to plug it into 100-volt 60-cycle current. Europe doesn't use 100-volt 60-cycle current, and I was unable to get a reliable power converter. The Starlet and its modem stayed behind after all.

ETH's Institut fur Informatik offered to get me connected to BIX, and I eagerly accepted; then they found out that no one in the Institut knew how to do it. They called the Computing Center, another branch of ETH, which sent around a very friendly chap to help me. It turns out that *every* ETH terminal has the capability for connecting to the outside world at 1200 baud; you only need a password. Thus, I got a BIX fix courtesy of ETH; otherwise, though, I've remained BIXless and will until we swing through Zurich on our way back to the Frankfurt airport.

PORTABILITY

The last time I was in Europe I carried Adelle, the Otrona Attache luggable.

(continued)

The Attache still works fine and has a built-in converter to European power, but it's just too darned heavy, or so I thought as I was packing. It is time, I told myself, to become truly portable.

That, it turns out, is more easily said than done. The HP 110 is portable. I have problems reading its screen, but I could probably live with it. Alas, I couldn't find a reliable way to recharge its batteries on European current; at least, no one I managed to get hold of at Hewlett-Packard could tell me how I could safely do it. The HP 110 I have has about 70K bytes of useful memory; hardly enough for a month's trip, even if I didn't have to worry about power and eyestrain. That eliminated it.

The NEC PC-8401 Starlet was a possibility. The memory problem looked severe at first, but then I found out about Purple Computing's SideStar, which is an external CMOS (complementary metal-oxide semiconductor) RAM (random-access read/write memory) disk that you can plug into the Starlet. Carry two of those and you've got *lots* of reliable memory. Furthermore, it's easy to dump onto any other machine when you return, since the Starlet knows how to connect to disks. Alas, the PC-8401's screen is even more difficult to read than the HP 110's. I was about to bring the Starlet anyway until I found that the modem wouldn't be usable; that was enough to decide against it. I am told that by the time you read this, NEC will have a greatly improved Starlet available, with an easier-to-read screen; but it wasn't available in late July when we caught the plane.

I was getting a little desperate when I found out about Purple Computing's Side*Car* memory module for the PC-8201. This plugs into the side of the 8201 and provides *four* banks of 32K-byte memory. The 8201 already has two internal 32K-byte banks, all nonvolatile CMOS (low-current) memory backed up with lithium batteries. In addition, I carried a couple of NEC memory cartridges for Percy; the result is that I've done both BYTE and *Popular Computing* columns, kept my notes, and written two chapters of a novel. I still have plenty of memory space left, and if I start running low, I have the NEC cassette data recorder in my luggage.

Percy's printer is a tiny little thermal affair; it produces a long, skinny output that looks like an adding-machine tape. I'm sure the BYTE people don't much appreciate it and wish I'd carried one of the larger printers, but if they saw my luggage, they'd sympathize. The little NEC printer is a lifesaver.

Fair warning about the PC-8201: if you get the printer, order spare paper well in advance. NEC national headquarters had to move heaven and earth to get several rolls to Los Angeles on two days' notice. For some reason, few NEC dealers stock the paper. Secondly, both the NEC printer and data recorder come with Japanese batteries. Throw them away. Don't even attempt to use them. They won't hurt the printer, but if the data recorder has low batteries, it can hang up so badly you have to cold-start the NEC PC-8201, and that loses all your data files, including the one you were trying to save.

Purple Computing sells internal memory chips for the 8201 in addition to SideCar. If you get an 8201—and I'm so happy with mine that it will remain as a truly portable backup no matter what other machine I carry in future—you'll want to deal with Purple.

In addition to slots for additional internal RAM (which you get from Purple), the 8201 has a slot for a ROM (read-only memory) chip. The best one I've seen for that is The Ultimate ROM from Traveling Software. This contains a number of interesting programs, including an idea processor I've used with some success in drafting this column. There's also a good text formatter that works with the TTXpress portable printer, also available from Traveling.

We've used Percy in hotels, in the car, on airplanes, and even at dinner at Schloss St. Rupert in Salzburg—our fellow diners were extremely curious about him. The only problem we've

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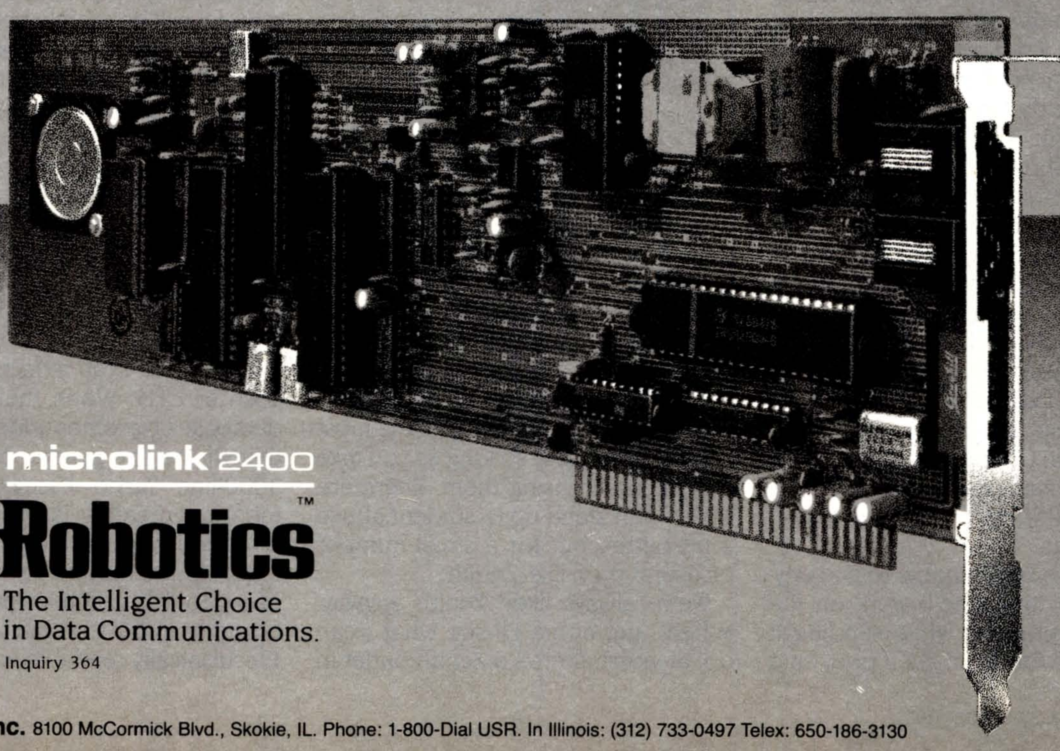


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had so far is that Mrs. Pournelle often wants to use him the same time I do; Percy is extremely easy to use, and she learned about him in no time. Next time she'll carry her own; Traveling Software has a good deal on 8201s, and I've ordered her one.

TERMINAL DIFFICULTIES

My daughter's job keeps her traveling; just now she's in Germany. Some time ago she asked me for an all-purpose computer she could use in various countries. It happened that Viasyn had just brought out the CompuPro 10, otherwise known in these columns as Shirley. Dr. Godbout's people were able to adapt it for European current, and I could get it at a good price, so over it went.

Viasyn didn't make terminals, so we looked about for one that would work in Europe and finally settled on a TeleVideo. Jenny was happy with it until one day it stopped working and a mysterious error appeared on the screen. No manual and no employee of TeleVideo seem able to explain that error message. It happens about 10 seconds after the terminal is turned on.

Jenny is not very computer-experienced, and trying to diagnose by intercontinental telephone is a losing proposition. When I got to her place in Germany, I did some tests: the first was simply to pull the plug from the TeleVideo to the CompuPro computer. Sure enough, the mysterious error message appeared anyway; so it wasn't something like the baud rate or a parity error.

The second thing I did was to connect the PC-8201 in terminal mode to the Shirley using the cable that formerly connected the TeleVideo. We booted Shirley. Everything worked fine. WRITE, WordStar, and SuperCalc all came up as usual. Of course, Shirley wasn't expecting a display 8 lines by 40 characters in size, so things looked a little odd, but otherwise it was all right.

Alas, we've been unable to find anyone in Germany who'll work on the TeleVideo terminal, while sending it back to the States costs money and requires complex paperwork. It looked simpler to buy her a new terminal.

I asked the people at ETH which terminals (for European current) they preferred for beginning students. Seems they'd done a study that indicated Zenith terminals give the most bang for the buck, so long as you take a little care in using them. There are others that stand up to student abuse a bit better, but for a small number of users, they like Zenith.

We've always liked Zenith anyway. When I get home I'll see what I can do; at worst, there's a Zenith outlet in Zurich. I can send them the money, and maybe somebody can help with the papers for getting it into Germany. Meanwhile, score one more use for Percy.

WINDING DOWN

I'm finishing this in the Salzburg Hotel at Zell am See, an Austrian resort town on a lake so clear it rivals Tahoe.

There's a problem about the book of the month: the only computer book I have with me is my own *Adventures in Microland*. Edward Luttwak's *Grand Strategy of the Roman Empire* (Johns Hopkins University Press, 1976) has been a fascinating travel companion as we toured the old Roman forts and bases, but that's a bit specialized. Even as I write this, my wife is giggling over *Deadly Games*, a novel about modern Russia by émigrés Edward Topol and Friedrich Neznansky (Berkeley, 1985), which I also enjoyed, and there's even a little about the primitive computing equipment available to the Moscow police; but I suppose the real book of the month has to be the August BYTE, which I stuffed into my briefcase as I went out the door. I have twice read it cover to cover.

There's a lot to think about in the August BYTE; but my main conclusion is that it will be a while before the new declarative languages take over from the procedural programming languages we have today. Certainly they're not going to have much of an impact on the micro world until we get implementations that work on our machines. ETH's Modula-Prolog for MS-DOS machines is just now becoming available, so maybe that will get interest going in the micro community.

Meanwhile, I can reflect on what I've seen at ETH. When their work with databases becomes widely available, that will be one generic advance. That 3000-line Turbo Pascal program I mentioned earlier is an indexing system for a videodisk of medical data. At NCC in Chicago, I saw a number of videodisk systems and new developments in CD (compact-disk) ROMs. Electronically readable encyclopedias

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are already on sale; next will be technical books with inserted *moving* illustrations accompanied by sound. None of this is more than a couple of years in the future—at least for hobbyists. The general public may have to wait longer.

The micro revolution continues, and we're right in the middle of it. I get to see the future before it happens. BYTE readers provide a continuous stream of information and ideas. I love it.

I do apologize for getting so far behind with my correspondence: my staff reports that though I almost caught up after the construction (happily finished), because of this vacation Chaos Manor is once again filled with archaeological layers of unanswered mail. When I get home I'll *read* it all, but realistically it's unlikely that I'll be able to answer more than a tenth of it.

Fortunately, the micro revolution provides solutions as well as problems: BIX gives me a fighting chance to, if not keep up with correspondence, at least not fall too far behind. Now if I can just persuade people to use BIX instead of the post office. . .

A last-minute bottom line.

First, an apology. In October, I left out the address for Don Castella of Disks Plus, and that's not fair; Don has done a lot of work setting me up an Ampro Little Board system, and he also knows a *lot* about Ciarcia's new small system. I recommend Disks Plus as a good source of inexpensive but powerful integrated hardware/software packages for writers.

Second, an observation. I've read this over, and it's amazing how working on an 8 by 40 screen can affect writing style; the sentences and paragraphs are shorter and choppier than what I usually write on my 16 by 64 system. When I discussed this with BYTE Editor in Chief Phil Lemmons, he wondered if Ogden Nash didn't write on a 2 by 40 machine, while historian Edward Gibbons used an 80 by 2000. . .

This working vacation has been just what I needed, but I'm astonished at how much I miss getting on line with BIX and generally playing about with small computers. I can hardly wait to get back to Chaos Manor, where we have new machines, new software, and mounds of mail. Recall Ogden Nash on sins of omission: "Whee! The next round of unanswered letters is on me. . ." ■

Jerry Pournelle welcomes readers' comments and opionions. Send a self-addressed, stamped envelope to Jerry Pournelle, c/o BYTE Publications, POB 372, Hancock, NH 03449. *Please put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply.*

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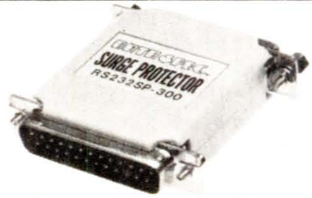
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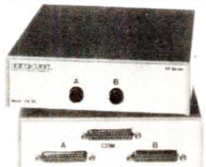
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Editor's note: Due to space limitations, we are able to publish only a sampling of the great amount of mail Jerry receives each month.

YET MORE ON COPY PROTECTION

Dear Jerry,

Since I am trying to make a living by selling my thoughts, I am in favor of copyright laws that protect me from being ripped off. And I just met a guy who specializes in pirating programs. He told me he had 13 word processors, 10 spreadsheets, lots of stuff like that, and that he hadn't paid a dime for any of them. As near as I could tell, he'd never used any of them, but that's not the point. He's wrong, and you and I both know it. If he photocopied one of your books and began selling it on street corners, I certainly expect that you'd be irked.

A school principal once asked me to lend him my Wildcard so he could make copies of an expensive program the school system had purchased. They had 28 machines, and the company wanted $200 for one disk, no backup, for each machine. The school system got a volume discount for the computers but couldn't get one for the software. It's one hell of a moral dilemma for a man who's supposed to set a good example to be, more or less, forced into theft in order to meet his commitment to society. Not only that, it was also a really stupid program, but through some hard-sell method that they used they were able to con the school system into buying it.

An even more ludicrous example of corporate greed was in the papers here recently. Seems a company, I'm not sure which one, was suing a computer store for violating the licensing agreement in using this company's product in training seminars they were conducting teaching businesspeople how to use the product. They evidently were using one program per machine (no hot copies) but were using the same copies for each class of trainees, instead of purchasing a new one for each user. Talk about a case of biting the hand that feeds you.

There's got to be some middle ground somewhere, a place where consumers and producers can fulfill their legitimate needs. I, for one, don't buy a lot of software, mostly because of price, but also because there's a lot of low-quality junk out there. I don't like copy-protected disks because, with my Apple at least, they always seem to mess with the DOS and then, if my drive is a bit off or whatever, I'm stuck with a zapped disk. Besides, nobody can write a perfect program that's perfect for all machines and all users, but maybe I can modify it to do something that the company never thought of. It saves me writing a whole program from scratch and, maybe, opens up a whole new market for you. There's no way I could market it without you knowing it's a variation of your program, and I'm willing to settle for a share of royalties. On the other hand, however, I probably could figure out a way to break your copy protection, but why waste my time? If it's a really good idea, I'm sure that I'm much better off doing the program from scratch and leaving you out in the cold.

Furthermore, if I buy a car and the engine goes bad or I just want to try a different one, I don't have to call the factory for permission to change it. I bought it, and it's mine. If I want to screw up the warranty, that's my business. There's lots of things I've seen that I'd pay $10 for, but they cost $29.95. Lots of $100 programs that I'd give $50 for. I haven't seen anything that I'd pay $100 for, but I've seen some stuff that would be worth more if I could mold it to fit my own needs, but I can't because it's on a copy-protected disk and it comes with some kind of stupid licensing agreement that seems to say I've only rented the thing, unless it goes bad, in which case I own it and the guy I rented it from doesn't have any obligation to make it right. Why should I waste my hard-earned money on a deal like that and still not have a program that will do what I want it to do? As for getting a hot copy, why bother? If it's not worth buying, why steal it?

It's time for the honorable people on both sides to get together and set some standards. If you sell me a fair program at a fair price, I won't let anyone else have a copy of it. If I've got more than one machine, let's talk about a volume discount. It's a lot of hassle for me to copy disks and manuals, but I don't feel I should pay full retail for each and every one of them.

I'll tell you the same thing I told the school principal: You can live in a swamp without crawling in the slime. Those who want to know how to break programs can find out without you compromising your integrity. Keep letting us know about honorable outfits like Borland, and we can deal with them. Despite what the experts say, integrity is more important than packaging. Let the rip-off artists deal with each other, but isolate them; they deserve each other.

Thanks for allowing me to ramble on in this long letter.

BRUCE NATTRASS
Madison, WI

Perhaps it's simply because it's traditional, but I see nothing fundamentally wrong with the way copyright protects books: when you buy a book, you own it, but you have no right to sell or give away copies, nor to keep a copy if you dispose of the original. The disabled and educational institutions have certain rights as well.

It's illegal but physically possible to borrow books from the library and make copies of them; fortunately, that's pretty difficult. Alas, it's much easier to make copies of software.

There's got to be an answer, and let's hope that we find it soon. Thanks for a thoughtful letter.

Best.—Jerry ■

HELP NEEDED

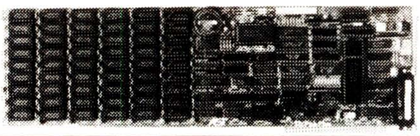
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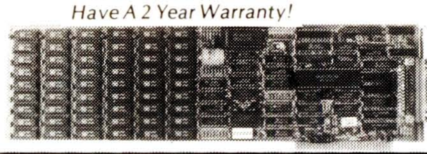
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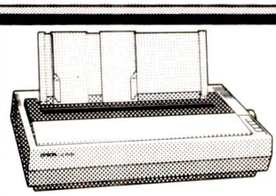
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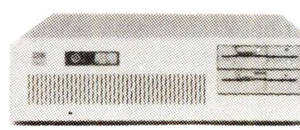
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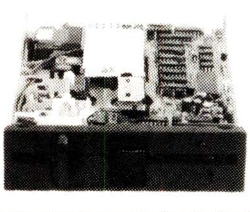
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The Torch Triple X

A UNIX machine for a (rumored) personal computer price

BY DICK POUNTAIN

Torch Computers Ltd. is one of the more successful British computer manufacturing firms, although it is not well known in the United States. Torch entered the computer business by providing peripherals for the Acorn BBC Micro (see BYTE U.K., September, page 385), a machine that never crossed the Atlantic in large numbers but is the second most popular home computer (after the Sinclair Spectrum) in the U.K.

When Acorn launched the BBC Micro (the Beeb) in 1981, the company promised a series of second processors (including the Z80 and National Semiconductor's 16032) to plug into the machine's high-speed bus, called the Tube. Acorn itself was slow to produce these second processors, and Torch Computers (Torch Computers Ltd., Abberley House, Great Shelford, Cambridge CB2 5LQ) was born to add the Z80 and CP/M capability to the Beeb. After some rather complicated politics, Torch's first product became a whole new computer, containing a BBC motherboard purchased from Acorn and a Z80 running CP/N, Torch's own CP/M-80–compatible operating system. With twin floppy disks, color graphics, and a built-in, post-office-approved modem (at a time when such things were rare), the machine certainly stood out from the throng of "identikit" CP/M boxes that dominated business computing in those days.

Torch went on to produce an add-on box for the Beeb, containing twin floppy-disk drives, a Z80 with its own 64K-byte RAM (random-access read/write memory), and CP/N, which proved to be a considerable success. It provided a relatively low-cost entry into CP/M in much the same way that Apple II Z80 cards did in the U.S.

This line of development—providing expansions to the Beeb, which Acorn had still not delivered—led Torch naturally into UNIX land. Again paralleling Apple in the U.S., the Beeb had found favor in university departments, as well as with the hobbyists, and these people wanted UNIX.

In 1983, Torch produced another (rather large) add-on box called the Unicorn, which contains both a 68000 and a Z80, runs both Berkeley System III UNIX and CP/N, and uses the Beeb as a color-graphics terminal. Over the intervening years, Torch has extended the Unicorn into a range of standalone UNIX personal computers and workstations, all based on the triple-processor architecture, integral communications hardware, networking, and the BBC sound and graphics facilities. As a result, Torch has quietly become one of the larger UNIX vendors in the U.K. (in terms of installed base, if not value), almost unnoticed by the specialist UNIX houses. A recent report on the UNIX marketplace in the U.K. ignored Torch altogether, concentrating on machines that cost more than £15,000.

THE TRIPLE X

From the earliest days of the company, Torch's designers had been working on a full-fledged UNIX computer, code-named the XXX or Triple X. Their experience with the Unicorn design radically altered this project; they more or less started again from scratch using the latest personal computer technology. Torch now has a product that is to be officially launched in January 1986 at London's "Which Computer" show. The product, a low-cost, mass-producible personal computer running UNIX System V and driven by Motorola's 68010 processor, has retained the Triple X name.

The machine is aimed at the same market as the AT&T UNIX PC, although it will probably be priced substantially lower. (Pricing was not decided at press time, although some adventurous figures being mentioned are nearer to the IBM Personal Computer than to typical UNIX prices.)

The Triple X (see photo 1) machine is a desktop computer with a small footprint—smaller than an IBM PC and about the same size as that of the Apricot from

(continued)

Dick Pountain is a technical author and software consultant living in London, England. He can be contacted c/o BYTE, POB 372, Hancock, NH 03449.

Apricot Inc. The console unit contains a single-board computer with a full megabyte of RAM, a single 720K-byte floppy-disk drive, and a 20-megabyte Winchester drive. A single power cord supplies both the console and display units, and the power switch is software-controlled so that the machine performs an orderly UNIX shutdown before finally removing power.

A tilting, swiveling 10-inch video-display unit sits on top of the console unit. This is a high-resolution color unit, capable of a maximum graphics resolution of 720 by 512 pixels. Torch uses this bit-mapped graphics capability to provide a Macintosh-style user interface to UNIX, complete with windows, icons, and a mouse. The Triple X supports multiple type fonts and laser-printer output, the latter via an integral Ethernet controller.

The Triple X's white injection-molded case permits modular expansion. The console unit is a sandwich of a base plate, a central rectangular ring, and a lid. The processor and memory motherboard fit into the base, while the central ring contains the disk drives, power supply, and fan. The central ring can be lifted clear for access. You can insert extra stacking rings containing extra drives or other peripherals into the sandwich. Alternatively, you can remove the ring, leaving a diskless workstation. Using the built-in VME bus interface, you can add an extra-deep ring that turns the console into a floor-standing minicomputer-style unit that may contain many VME cards and extra power supplies.

HARDWARE DESIGN

The Triple X is designed around the 68010 processor, which runs at 8 MHz, working in conjunction with the 68451 MMU (memory-management unit) and 68450 DMA (direct memory access) controller to support virtual-memory operation in the 1-megabyte main memory space.

A 6303 single-chip microcomputer with on-chip RAM and ROM (read-only memory) acts as a service processor, which controls the video modes and color palette, a battery-backed clock with some CMOS (complementary metal-oxide semiconductor) setup memory, keyboard and mouse, sound generation, serial communications links, and a 1-MHz peripheral bus. This second processor insulates the devices it controls from the activities of the UNIX system so that, for instance, the mouse can move the screen cursor in real time without interference from UNIX tasks. It also relieves UNIX from any potential video synchronization problems when changing screen modes. The video system has its own separate 64K bytes of RAM, part of which is double-ported to serve as a message-passing area for communications between the 68010 and the service processor.

The service processor conducts power-up diagnostic checks and ascertains what devices exist in the system before it bootstraps the 68010. If an optional on-board modem is present, the service processor can perform remote diagnostics on failure of the main processor.

Despite the lack of any dedicated hardware graphics processor, screen refresh and raster moves (for example, dragging windows or icons) are exceptionally quick; the powerful peripheral chips and service processor appear to leave the 68010 with plenty of steam to perform these chores.

The amount of video memory provided is sufficient to allow 720 by 512 pixels in two colors (1 bit per pixel), 720 by 256 pixels in four colors (2 bits per pixel), or 360 by 256 pixels in 16 colors (4 bits per pixel). The normal operating mode is 720 by 256 pixels, which provides sufficient resolution to produce normal, bold, and italic type styles with excellent clarity on the screen. As on the Macintosh, the choice of a small 10-inch screen format improves the perceived clarity of

(continued)



Photo 1: *The Torch Triple X microcomputer.*

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Equivalent Program Segments

```
;-------PROMAL--------
REPEAT
   PROMPT_AT 5,24, "Add/Chg/Quit?"
   IF Reply = 'A'
      ADD Item
      New_Items = New_Items + 1
   ELSE IF Reply = 'C'
      CHANGE Item
UNTIL Reply = 'Q'
```

```
11910 REM-----BASIC----------
11920 CL=5:LN=24:PR$="Add/Chg/Quit?"
11925 GOSUB 9490:REM GET REPLY
11930 IF RP$<>"A" THEN 11950
11940 I9=IT:GOSUB 10100:REM ADD
11945 NI=NI+1:GOTO 11920
11950 IF RP$<>"C" THEN 11970
11960 I9=IT:GOSUB 6050:REM CHG
11970 IF RP$<>"Q" THEN 11920
```

PROMAL is readable and understandable. You see the logic from the structure. And PROMAL lets you call procedures by name – so no more GOSUBs. But there's more.

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- Multi-Dimensional Arrays (any type)
- Strings & pointers
- Control Statements: IF, IF-ELSE, WHILE, FOR, CHOOSE, REPEAT-UNTIL, BREAK, NEXT, INCLUDE, ESCAPE, REFUGE
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- Simple Machine Language interface
- Recursion supported
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- Memory MAP, SET, and display commands

EDITOR

- Full-screen, cursor driven
- Function key controlled
- Line insert, delete, search
- String search and replace
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LIBRARY

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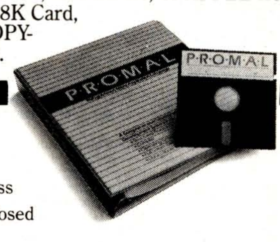
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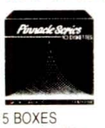
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You can select colors interactively with a palette editor, allowing control of red, green, and blue levels.

the displayed characters.

The color selection is extremely flexible. The physical color palette is a 16 by 8 RAM under the control of the 6303, into which bytes are stored to select the 16 displayable colors. Each palette byte controls the intensities of the red, green, and blue beams in the monitor, with 3 bits each devoted to red and green (eight levels) and 2 bits to blue (four levels). This allows 16 colors to be chosen arbitrarily from a possible 256. There are two logical palettes, *mark* and *flash*, allowing flashing displays that cyclically swap from one to the other.

You can use all 16 colors in screen mode 1 (360 by 256 pixels). In the normal screen mode (720 by 256 pixels), you can only use 4 actual hues, but 16 halftone tints are available if you mix all the pairs; these tints are subtle and show no visible halftone pattern at all. You can select colors interactively with a palette editor, allowing direct control of the red, green, and blue levels, which are displayed as a bar chart. You may alter these levels with the mouse; since changes take effect immediately, you can even use it for color matching.

Communications on the Triple X are handled by two more built-in devices, a Zilog SCC (serial-communications controller) and the Lance Ethernet controller. The back panel provides two serial data channels with D-type connectors. One is configured as RS-423A and the other as X.25, but you may reconfigure them both with software to support high-speed synchronous protocols such as HDLC (high-level data-link control) and SDLC (synchronous data-link control). The Ethernet controller uses DMA to avoid buffering and can operate concurrently with the central processor.

The detachable keyboard has 10 function keys, a numeric pad, and four cursor-control keys. It uses a layout that is vaguely IBM-like but has superior key placements and sizes (e.g., a huge L-shaped Return key). It is completely *soft*, and you can program any key from the UNIX shell to generate a string.

The mouse is a two-button serial device. On the prototype machine I tested, it plugged into the RS-423A port, but on the production models it will have its own socket.

The main board contains a VME bus interface so that you can use the Triple X as a processor card in VME systems. Torch has prototypes of a 68020 processor board that can use Triple X boards as device controllers in a multiprocessing VME system; the Triple X slave processors write directly into the 68020's memory for fast communication.

SOFTWARE DESIGN

The Triple X's operating system is UniPlus + System V, an implementation of UNIX System V from UniSoft Systems, ported for Torch by Root Computers Ltd. of England. It's a complete UNIX implementation with the Berkeley enhancements, Root's enhancements (for unbuffered DMA) disk access and code sharing between processes, and Torch's own extensions to handle a bit-mapped-graphics (rather than a character-oriented) display device.

The Torch MMI (man-machine interface) is mostly built into the UNIX kernel for maximum speed; it never gets swapped out of memory just when you need it. User programs can access the MMI either through direct system calls or through an extensive C library provided with the Triple X.

The interface between UNIX proper and the MMI promotes compatibility with standard UNIX software. UNIX sees a console driver to which it sends a character output stream in the normal fashion, oblivious to the

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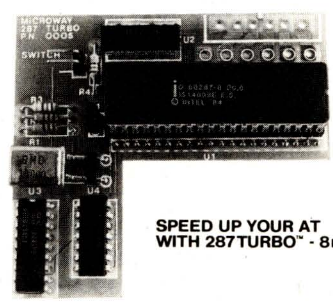
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very different processing that these characters receive inside the MMI.

Special Triple X features are organized into three categories, in ascending order of complexity, which are invoked by one of three methods: sending control characters, escape sequences, or calls to the ioctl routine. This permits standard UNIX software to use the basic features such as type styles and colors without modification and the others with fairly minor modification.

The MMI is composed of nine manager modules. Eight of them are part of the UNIX kernel: window manager, keyboard and mouse manager, menu manager, font and text manager, graphics manager, event manager, icon manager, and track manager; the desktop manager is a *process* that provides a mouse, window, and icon shell. The experienced user can modify it fairly easily.

In my limited use of the Torch MMI, I found it to be a thorough inplementation. It appears at least as "deep" as the Macintosh operating system and goes well beyond it in places. It's constructed on classic Xerox PARC lines, starting from the BitBlt routine that performs basic raster copying, shading, and clipping, although Torch's BitBlt incorporates the handling of color bit planes. All visual objects, from a point up to the whole screen, are represented by *forms*. A form consists of a bit map and the parameters that specify its dimensions and colors. BitBlt manipulates these forms.

The graphics manager, called TorchDraw, is built on top of BitBlt. It supports line, ellipse, and arc drawing, area fills, rectangle framing, clipping, scrolling, and more. The drawing pen may be any form of arbitrary size, not just a point, and so the placement of icons and mouse cursors becomes an ordinary act of plotting.

Forms of arbitrary size also represent type fonts, with style (normal, bold, or italic) kept as a separate attribute that you can toggle by sending control codes. Torch has commissioned professional typographers to create a series of ISO (International Standards Organization) fonts with typeset-quality attributes, such as proportional spacing and kerning.

Torch loaned me a preproduction version of the machine on which the lower layers were all in place, but the desktop manager was only partially complete. Therefore, the following description comes partly from direct experience and partly from the programmers' specification documents for yet-to-be-implemented features.

The desktop metaphor is similar to that of the Macintosh (except that it's

(continued)

One feature of the Triple X that appeared novel to me is the superimposition of icons.

in color); it employs a group of icons presented on the screen that you can drag or click on. The left mouse button selects single icons; the right button, groups of icons.

Files are classified as tools (i.e., executable processes), data, or folders (i.e., UNIX directories). The system provides standard icons to represent these three types. Each directory may contain a file called desktop, so that many desktops can exist in the system; different users may each have their own. In each folder there may also be a file called icons that allocates user-defined icons (created with a supplied icon editor) to specific files. These override the default icons and display when you open the folder representing the directory. Icon bit maps are named and stored in files in a system directory called /icons; they are allocated to files indirectly, using their names, so that if you modify an icon, the new version automatically replaces every instance of its use.

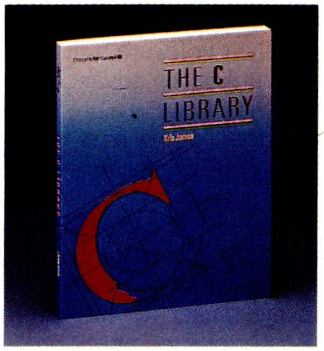
One feature that appeared novel to me is the superimposition of icons. You can give a data file to a program as an argument by dragging its icon on top of the program icon, an extension of the trash-can usage in previous systems.

The Triple X supports hierarchical directories in a natural way. Opening a folder by double clicking creates a new window revealing other folders that you can open. You can only have one folder window active (on top) at one time, but you can have many visible on the screen, and you can bring another one to the top in the usual way by clicking in it. You can drag tool and data icons out of a folder onto the desktop and copy them by dragging them onto another folder. A file dragged to the desktop stays there even when you close its folder, and you should replace it after you're through using it. You can drag data files from the desktop onto tools in other open folders, and certain tools (for example, ls) accept whole folders as arguments. UNIX is a multitasking system; therefore, you can have different processes running in different windows, which means that you can click and activate some kinds of icons

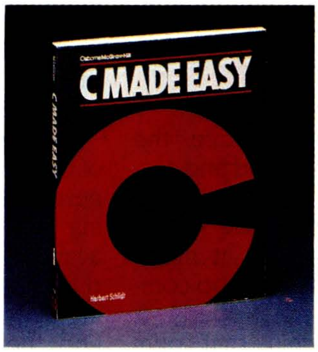
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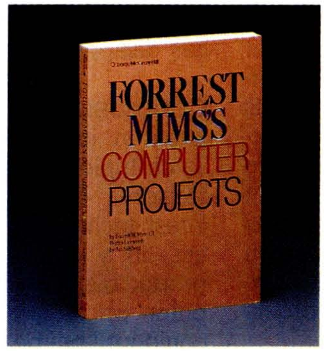
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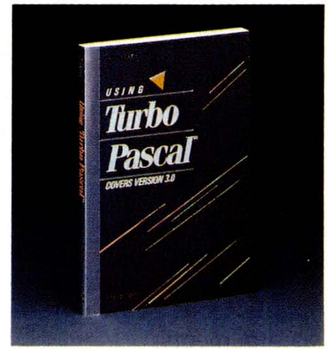
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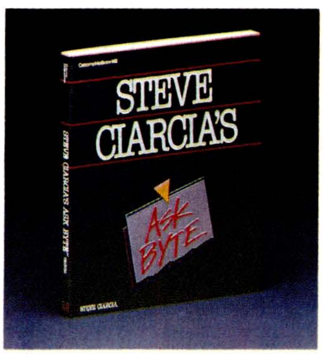
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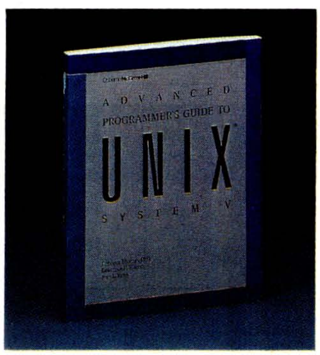
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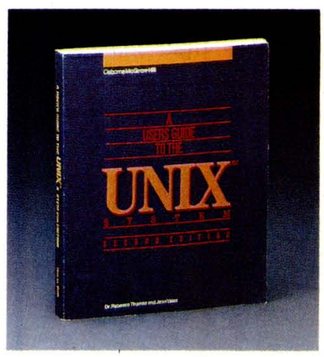
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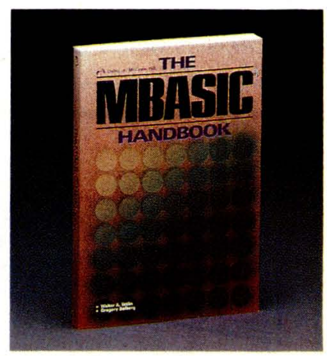
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more than one time.

Double clicking to activate icons is more flexible than in previous systems I've seen. The icons file specifies what action, defined by UNIX shell commands, should occur when an icon is double-clicked. There are default actions: no action for a data file and the program name itself for a tool, but you can insert any arbitrarily complex action instead. This file also lets you define some icons as *acceptors* (for example, icons that can receive others as arguments).

The MMI integrates transparently with UNIX, since you can always open a window and issue shell commands in the normal way. But for the non-enthusiast, using icons and pointing is tremendously effective in cushioning you from the brutality of the UNIX user interface. If developers would give sensible names to all the utility programs as well, I would be a complete convert. Since you no longer need to type them, the rationale for monosyllabic monstrosities like grep has disappeared.

CONCLUSIONS

Even in its prototypical state, the Torch Triple X has a polished and professional design that exploits the latest technology (256K-byte RAMs, etc.) in a way that makes it mass-producible at ordinary desktop computer prices. Handled properly, it could well be the machine that spurs the long-awaited UNIX takeoff. The excellent user interface overcomes most of the objections against UNIX as an operating system for ordinary mortals.

The only remaining question concerns the amount of application software available under UNIX. Here, Torch is taking an active stance. Rather than talking about third-party support, they have commissioned standard applications, including a word processor and spreadsheet from a London-based UNIX software house, that should fully utilize the advanced user interface.

If the launch price is as low as some of the figures currently circulating suggest, Torch will have no trouble selling the machine to its traditional academic and scientific customers. In pursuing the longer-term goal of selling to the business user, Torch may find the most serious competition coming, paradoxically, from the Commodore Amiga rather than the AT&T UNIX PC, which I think looks rather drab by comparison.

The Triple X is unlikely to be sold in the U.S. by Torch; in fact Torch is looking for a major U.S. company to manufacture it. A deal is close as this column goes to press, so keep an eye open for the announcement. ■

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FP OPERATIONS	*0:52.12*	*0:31.75*
FP OPERATIONS (8087)	*0:01.97*	*0:06.21*
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EDITOR FILESIZE LIMIT	*MEMORY SIZE*	*64K*
COMPILE ERROR CALLS EDITOR	*YES*	*YES*
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Turbo Pascal without 8087 uses only 6-byte accuracy for type REAL; M2SDS with or without 8087 uses 8-byte accuracy.
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バイト

Computing in Taiwan

The Computex '85 computer show and a look at software piracy

BY WILLIAM M. RAIKE

This month, BYTE Japan could be called BYTE Asia. The entire BYTE Japan staff (namely, me) selflessly agreed to visit Taiwan for a few days to report on the Computex '85 computer show held there during the week of July 12–18. I also wanted to check out the rumors I've heard concerning software (and hardware) piracy in that country.

It had been three years since I last visited the city of Taipei, one of Asia's premier economic miracles. New construction is erupting everywhere, the air pollution and traffic are even worse than before, the Chinese (and Taiwanese) food is as good as ever, and there are hundreds upon hundreds of small- and medium-size companies turning out high-quality personal computers at incredibly low prices. If you want to buy computer equipment and are planning to visit this part of the world soon, the potential savings on equipment combined with the low cost of travel and lodging might make it worthwhile for you to stop in Taiwan.

THE SHOW

Computex '85 was held under the auspices of Taiwan's China External Trade Development Council (CETDC) in its huge exhibition hall at the Sungshan domestic airport. The overwhelming majority of exhibitors were offering equipment compatible with the IBM PC or the IBM PC XT computers. As regular BYTE Japan readers know, this situation is completely different from the one in Japan, where IBM PC compatibility isn't even an issue. Most of the computers were straight-out clones, but I saw a number of innovative ideas, including IBM PC- and Apple-compatible portable computers and an interesting new machine based on the 80186 processor.

ERSO BIOS

How, I wondered, do these small companies manage to legally produce IBM PC-compatible machines without investing large amounts of money to develop their own BIOS (basic input/output system)—the nuts-and-bolts software that underlies the operating system and lets the machine run? How do they avoid infringement lawsuit problems?

I got an answer I hadn't expected. An organization called ERSO (the Electronics Research and Service Organization, sponsored by the Taiwanese government) has developed its own BIOS, which it claims is acceptable to IBM as noninfringing. For modest fees, small computer manufacturers can obtain licenses for the ERSO BIOS. That way, they avoid the need for large software-development outlays and escape the risk of serious legal entanglements when they attempt to export to the United States, which is clearly their target market.

The same thing could have been done by a private organization, but the Taiwanese government had strong reasons to become involved: It needs to make visible efforts to put a stop to the export of illegal copies of proprietary hardware and software. The ERSO BIOS makes an appealing carrot; the accompanying stick is an apparent determination by the Taiwanese government, at the behest of the CETDC, to prosecute computer pirates. In early June, the Taiwan Supreme Court confirmed jail sentences for three people convicted of selling illegal copies of Apple II manuals and software. Earlier, another manufacturer was sentenced to a year in jail and fined for illegally copying IBM software. Current Taiwanese law calls for a jail sentence of up to five years for manufacturing counterfeit goods and up to one year for selling or exhibiting them.

Another government move to discourage computer pirates becomes evident when you go to the airport to leave the country. Taiwan is one of the few places I've been to that requires a customs inspection for departing passengers. A specific item on the declaration form asks you to list any computer disks, tapes, or other software

(continued)

William M. Raike, who has a Ph.D. in applied mathematics from Northwestern University, has taught operations research and computer science in Austin, Texas, and Monterey, California. He holds a patent on a voice scrambler and was formerly an officer of Cryptext Corporation in the U.S. In 1980, he went to Japan looking for 64K-bit RAMs. He has been there ever since as a technical translator and a software developer. He can be contacted c/o BYTE, POB 372, Hancock, NH 03449.

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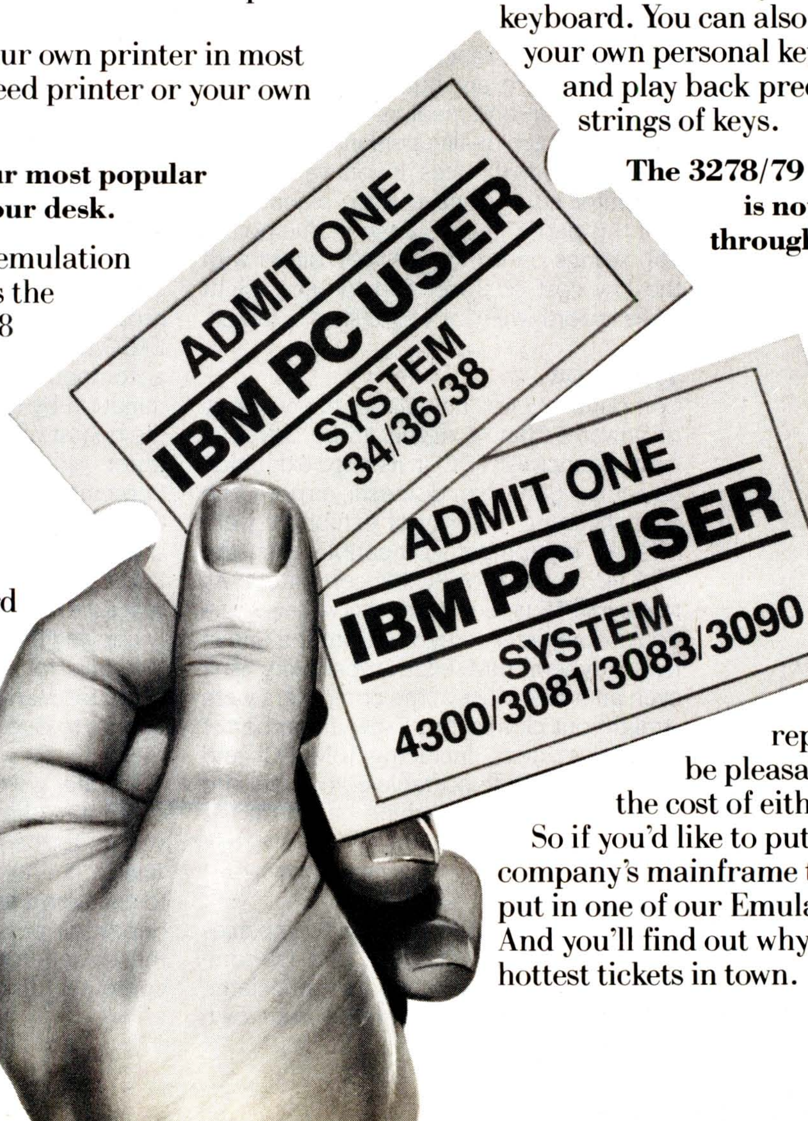
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The ERSO BIOS apparently hasn't discouraged technological competition. Some companies producing IBM-compatible machines have chosen, either independently or in partnership with U.S. firms, to develop their own BIOSes, bypassing the government effort. They claim that their BIOSes are faster than the ERSO version, while maintaining full IBM PC compatibility.

THE LEO PERSONAL COMPUTER

One of the most interesting machines at Computex '85 was the LEO AT/XT from First International Computer Inc. (see photo 1). The LEO isn't really an IBM clone, but the company claims that it is fully compatible with the IBM PC XT and has some of the features of the PC AT as well.

The LEO is based on an 80186 microprocessor (the same type as in my Fujitsu FM-16β computer) running at 8 MHz; it's supposed to be about three times as fast as the IBM PC XT. It uses some kind of dual-bus architecture; a spokesperson for the company wasn't specific. The LEO has its own BIOS, developed in cooperation with an American company, and First International Computer claims it will run either MS-DOS or PC-DOS as well as Concurrent CP/M-86. I saw it running several popular application software products, including Lotus Development Corporation's 1-2-3.

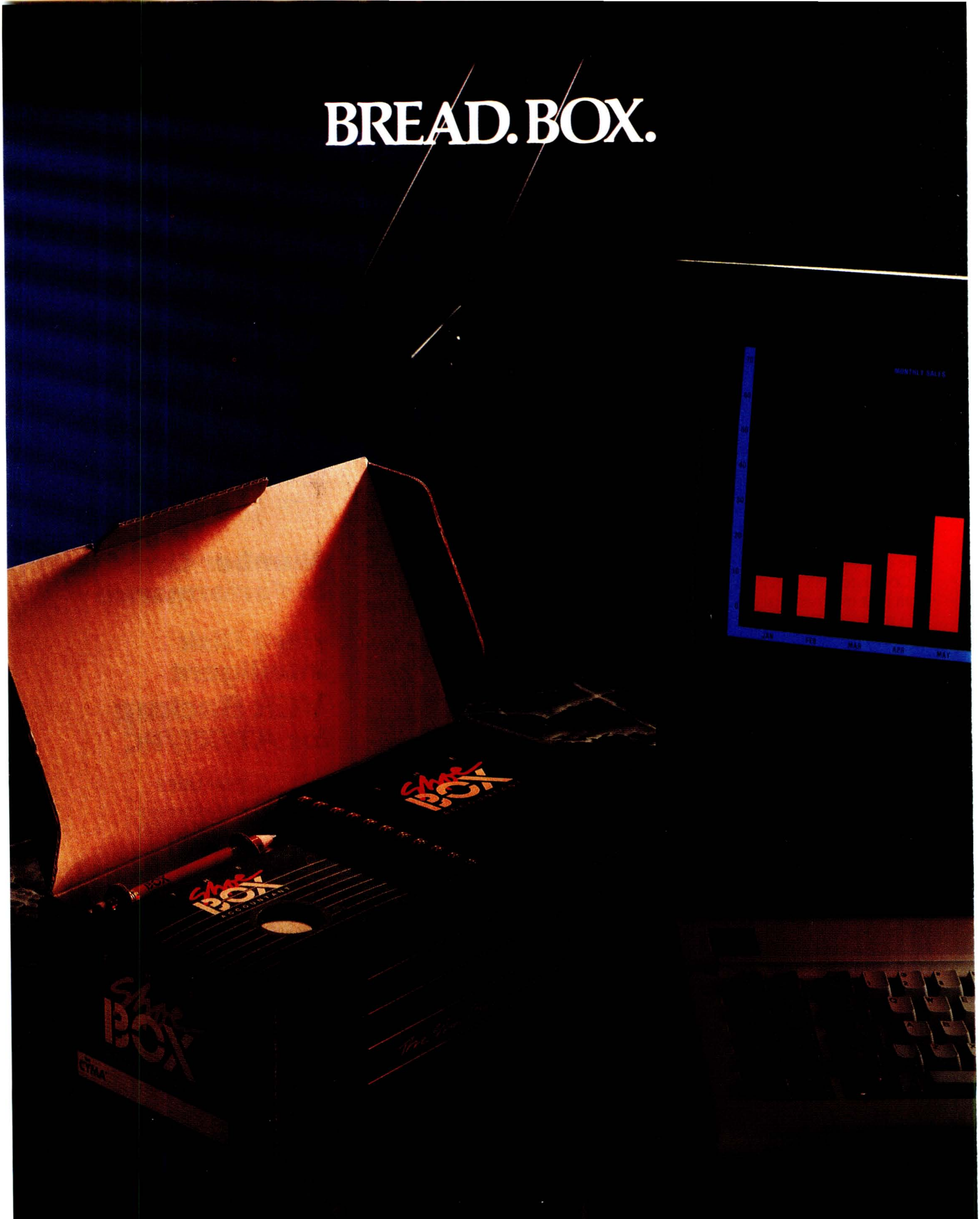
The LEO comes in three configurations; all have 512K bytes of memory on the main board (you can expand the memory up to 1 megabyte by adding a memory board) and include a keyboard and a color-graphics card as well as a floppy-disk controller, Centronics-compatible printer port, and RS-232C serial interface.

The differences between the three versions involve the disk drives. The top-of-the-line model, the LEO AT/XT-2, includes one 360K-byte floppy-disk drive, one 1.2-megabyte floppy-

(continued)



Photo 1: *The* LEO AT/XT *personal computer.*


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disk drive, and a 20-megabyte hard-disk drive with controller. Its price, in U.S. dollars, in quantities up to 11 units, is $2165. The LEO AT/XT-1 model is the same, except it doesn't include the 1.2-megabyte floppy-disk drive; its price is $1995. You can also buy a LEO AT/PC model for $1270; this version comes with two 360K-byte floppy-disk drives, but no hard-disk drive.

A novel feature of the LEO series is that, of the five expansion slots on the main board, two slots accept cards designed for the IBM PC AT and compatibles, while the remaining three slots are IBM PC XT-compatible. Furthermore, the manufacturer says that the LEO can run MS-DOS 3.0. These features really put the LEO into a class somewhere between the IBM PC XT and the PC AT; the availability of an 80286 processor card next year ought to make the machine even more versatile.

IBM PC XT AND IBM PC AT CLONES EVERYWHERE

I couldn't even count the companies that were exhibiting look-alikes for the IBM PC, PC XT, and PC AT. To give you an idea of prices, here are some typical examples.

The model HT-320 computer from OST-EMPOR Electronics Company Ltd. is an IBM PC AT-compatible machine. It includes 640K bytes of memory on the main board, with eight expansion slots, a color-graphics card, keyboard, and a single 1.2-megabyte floppy-disk drive. No hard-disk drive is included. The price for a single unit is $2050.

TECA Engineering Company Ltd. offers both components and assembled computers in IBM PC-, PC XT- and PC AT-compatible models. The IBM PC-compatible version, with dual floppy-disk drives, 256K bytes of memory on the main board, and a 12-inch monochrome monitor, costs $747. The IBM PC XT version, including hard-disk drive and controller, sells for $1100. An IBM PC AT-compatible version, with 512K bytes of memory and an 80286 processor, one 1.2-megabyte floppy-disk drive, and one 20-megabyte hard-disk drive, has a list price of $2800.

(continued)

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The ASI-500 computer from Aquarius Systems Inc. is fully IBM PC XT-compatible and runs the government-developed ERSO BIOS. It has 640K bytes of on-board memory and includes a single 320K-byte floppy-disk drive and a 10-megabyte hard disk. It comes with MS-DOS 2.11, but no monitor or color-graphics board is included. The list price is $1130. A dual-floppy version with only 128K bytes of memory sells for only $600.

Autosim Company Ltd. produces the Touch-1 computer, an IBM PC XT-compatible. With 256K bytes of on-board memory, a single 320K-byte floppy-disk drive, and a color-graphics card, it sells for $395. A slim-type 10-megabyte hard disk and controller will set you back an additional $550. The best thing about this computer is its keyboard (available separately for $55); I think its layout and touch are about 100 percent better than that of the standard IBM PC keyboard.

The Kingtech KS-200 portable IBM PC XT-compatible from K.S. Brotherbox Company Ltd. sells for $750, with 640K bytes of memory, dual 360K-byte floppy-disk drives, and a built-in 9-inch green monitor. Or you can order the KS-200A with a hard-disk drive instead of one of the floppy-disk drives for $1150. The keyboard is detached and has the standard IBM PC layout.

The IMC JR+ from IMC Group is a laptop portable IBM PC-compatible, but it doesn't have a built-in display. It does have 256K bytes of memory, a color-graphics board, and one built-in 5¼-inch 320K-byte floppy-disk drive. The list price is only $475. The same company makes a portable IBM PC-compatible machine that includes a 9-inch green monitor and two floppy-disk drives for $755. It also offers an IBM PC XT-compatible machine with a 10-megabyte hard disk and 256K bytes of memory for $1055, or with 640K bytes of memory for $1120. IMC Group uses a proprietary BIOS that was developed in the U.S.

Software Piracy Close-up

Regular readers of this column know that my computer is a Fujitsu FM-16β, which is not at all IBM PC-compatible. In fact, I run the CP/M-86 operating system, not MS-DOS, so I have no need for IBM PC software. Nevertheless, having heard so many rumors about pirate software shops in Taiwan, I decided to check it out myself.

One shop measured up to my worst expectations. Its catalog consists of a list of over 300 well-known software packages, including Lotus's 1-2-3 and Symphony, Ashton-Tate's Framework, and numerous compilers, spreadsheets, word processors, and other application programs marketed by major companies in the U.S. and throughout the world. The store also offers hundreds of books, including manuals for the software it sells. All of this is illegal, all of it is pirated. The software is sold for $10 per disk. I asked to see three well-known programs; they were brought out of the storeroom and demonstrated. Not one of the disks had a label from the original manufacturer. Since I was testing three disks, I was offered a discount: three disks for $20. The salesperson said, "Please wait a moment; we'll copy these right now," and proceeded to do just that. I couldn't resist the temptation to ask, "How is it that you can offer such expensive software for such a low price?" The salesperson confided to me, "I think this is a little bit illegal. You should hide these from Customs when you go to the airport."

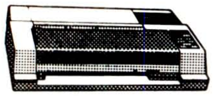
Don't write and ask me the address of the shop; with any luck, by the time you read this the Taiwanese government will have closed down the operation. In the meantime, the only thing I can say to U.S. software suppliers is that sending software to Taiwan may be issuing a license to steal. If I were a major software company, I'd consider hiring a permanent representative in Taiwan just to file complaints against software pirates.

Coming Up

Next month I'll take a look at new models of the NEC PC-9801 series. I'll also discuss the DynaMac and some software that bridges the East-West language gap. ■

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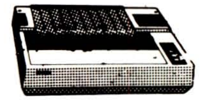
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Microcomputer Color Graphics—Observations

BY BRUCE WEBSTER

I'm sure most of you haven't the slightest interest in my personal affairs, but I'm about to move to another state, and Jerry Pournelle's appellation for his chaotic home fits my own house (not to mention my life) all too well. As a result, much of the software waiting to be examined waits still, and hardware shipments have stopped altogether until I have a new address at which to receive them. Your patience is requested and appreciated.

Those of you who have written me physical letters deserve a special public apology. From where I am sitting, I can turn my head and see a 2-inch stack of letters awaiting answers, some of which are older than I can comfortably think about. My goal is to answer them before The Big Move next week and thereafter stay on top of things, answering all letters promptly. And, as my friend's grandmother says, if you believe that, I'll tell you another one.

MAC COMMUNICATIONS SOFTWARE

As you may recall, last month's column was written on the Macintosh for the first time (using Microsoft Word). Well, I'm back on the Compaq this month. Not because of word-processing problems on the Mac; even now, I find myself reaching for the mouse. No, the problem lies with the only telecom program I have for the Mac: MacTerminal. I had a very difficult time doing a simple ASCII upload of my column to BIX (BYTE Information Exchange), mostly due to the lack of a "wait for prompt" feature in MacTerminal. That, of course, was on top of many other deficiencies and proved to be the proverbial backbreaking straw. The real culprits are ASCII Pro and Crosstalk, the two telecom programs I use on the Compaq. Both can do so much that MacTerminal seems primitive by comparison.

After asking around, I've found that the Mac package most often recommended is Red Ryder, a shareware package available through many users groups and bulletin boards. I hope to have a copy by next month, in which case I'll probably switch back to the Mac for writing. Hayes Smartcom II for the Mac also looks good, although I've heard that it doesn't work well with the Apple modem. You should use a Hayes Smartmodem with it. I'll try to have more detailed reports on both these packages in the next month or so; in the meantime, do *not* buy MacTerminal.

COLOR GRAPHICS VERSUS MONOCHROME

Many rumors are now surfacing about future Mac products. Supposedly, Apple will be releasing a Big Mac by the time this column sees print; said Mac will reportedly come with 1 megabyte of RAM (random-access read/write memory), the new 128K-byte ROM (read-only memory), and a double-sided (800K bytes) disk drive, all in the standard Mac box. More intriguing is the talk about Carla, a 2-megabyte Mac with dual 68000 processors, slots, and different-size monitors (including a 9- by 12-inch full-page version). And it just possibly may have color output. Of course, rumors and sightings of a color Mac have been around almost as long as the machine itself. Steve Jobs asserted last January that no color Mac would surface for a few years at least, until such time as a color equivalent of the LaserWriter was feasible. He contended that color wasn't that important and said the Mac community was far better off working toward higher-resolution monochrome display and reproduction.

There haven't been too many issues on which I've agreed with Jobs, but this is one. The following appeared in my review of the Macintosh in the August 1984 issue of BYTE:

"Some criticism has been made about the lack of a color-graphics capability. Frankly, I am unconvinced of its necessity. Most applications I have seen use color graphics as

(continued)

Bruce Webster is a consulting editor for BYTE. *He can be contacted c/o* BYTE, POB 1910, Orem, UT 84057, *or on* BIX *as bwebster.*

The 68000 processor in the Mac has to do everything and quickly becomes the bottleneck for the system.

a substitute for detail, and the Mac can give you lots of detail."

Since then, little has happened to change my mind; the Mac, with its square pixels and amazing graphics routines, still has the cleanest, most professional display of any microcomputer I've worked with. But technology is starting to catch up with Apple, and crisp, fast color graphics in equal or higher resolution are showing up on the Atari 520ST, the Amiga, and some of the new graphics boards for the IBM PC. And while these newcomers don't have software libraries anywhere close to the Mac Toolbox, they do have greater hardware support, resulting in very fast display updates. By contrast, the 68000 processor in the Mac has to do everything and quickly becomes the bottleneck for the system.

Still, a monochrome display has many advantages over color graphics. It is usually easier to read than a color display of equal resolution. As Jobs noted, image-manipulation and -reproduction technology (printers, digitizers, etc.) is more advanced for monochrome displays, and "what you see is what you get" displays are easier to support. Monochrome displays require less memory than color displays of equal or even less resolution, something important for a machine (the Mac) still officially limited to 512K bytes. Finally, high-resolution monochrome monitors are cheaper than equivalent-resolution color monitors.

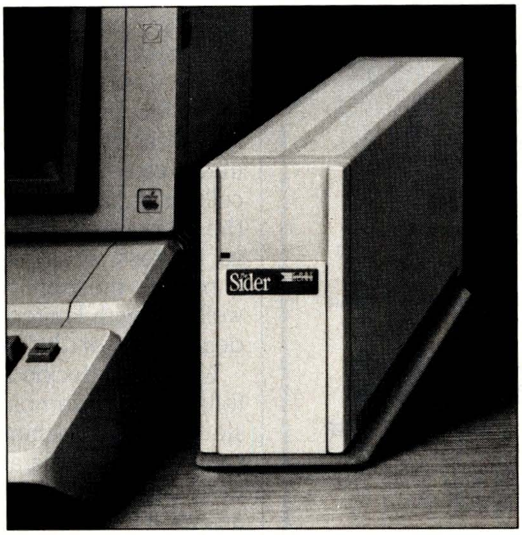
A Brief Survey of Graphics

The development of graphics technology is itself fascinating. The first real breakthrough was the Apple II, which offered graphics—and color graphics, at that—as a standard feature. I still have the June 1977 issue of BYTE with Apple's first ad in it, and I can still remember the feelings of computer lust it stirred in me. None of the mainframes and minis I was working with at school had color graphics, and here was a microcomputer that could do it all.

Unfortunately, the graphics on the Apple were not particularly easy to use (and still aren't, although they are well documented now, eight years later). The high-resolution graphics mode—280 by 192 pixels (monochrome) or 140 by 129 pixels (six colors)—used a bizarre mapping scheme, reputedly chosen by Steve Wozniak to save a few TTL (transistor-transistor logic) gates in the design. And the display RAM itself was fixed right in the middle of the memory map. This wasn't much of a problem when RAM prices were high—that same ad offers 16K bytes of RAM

(continued)

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for $600—but once 32K- and 48K-byte systems became popular, the location became one more problem to work around.

The Apple II established built-in color graphics as a standard for personal computers; the Atari 400/800 and the Commodore 64 built upon that standard, adding hardware support, relocatable video RAM, missiles and sprites, and other features. Programmers on these machines had a much easier time of it, and some impressive programs (read: games) were produced. However, because of the cellular nature of the graphics on these systems, most of the programs had a "chunky" look to them and were not as impressive as the most advanced programs (read: games) on the more primitive Apple II. Both machines sold well but, with limited expansion capability, tended to be dead ends for their owners.

When IBM decided to get into the micro world, it wisely followed the example of the Apple II and put expansion slots into the machine. Then, for some incomprehensible reason, the people at IBM did not make graphics a standard part of their system; in fact, they did not even make an ASCII text display a standard feature. Instead, they offered two incompatible display cards: one for monochromatic text display, the other for color text and graphics. And, just to add to the excitement, they designed their cards and monitors such that if you plugged your monochrome monitor into your color card, you stood a good chance of burning out your monitor.

In retrospect, a couple of reasons suggest themselves for this design philosophy, none of them flattering to IBM. Possibly, IBM was unwilling to give its customers a standard graphics capability (or even a standard ASCII display, for crying out loud) but wanted to charge extra for these "options." Or perhaps IBM was somehow afraid that making graphics (especially color graphics) a standard feature would "lower" its system to the level of the Apple/Atari/Commodore computers, which most people viewed as game machines.

Whatever the reasons, the results are obvious today: a wide variety of display cards, with varying levels of compatibility between each other and your software. IBM has gotten right in there with the rest of them, not only offering the monochrome (text) display adapter and the color-graphics card, but also the Extended Graphics Adapter (EGA) and the very expensive Professional Graphics System. And if you want clear, crisp text and color graphics on the same system, be prepared to do some juggling of both software and hardware. (I haven't even mentioned the problems of conflicting parallel ports on different display cards.)

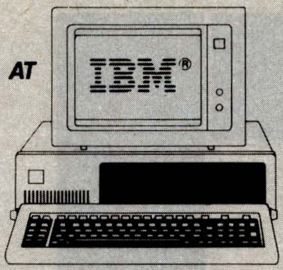
On top of this, the standard IBM graphics aren't very exciting. You have a few different resolutions to choose from; the most common are 640 by 200 pixels (monochrome), 320 by 200 pixels (monochrome), and 320 by 200 pixels (four colors). The RAM-to-display mapping isn't that bad, but the color selection is disappointing: one of

(continued)

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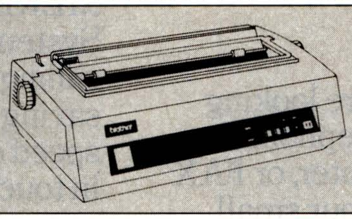
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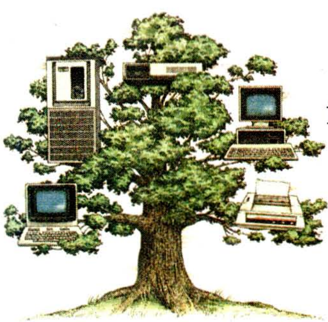
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ACCORDING TO WEBSTER

The IBM PC, XT, *and compatibles allow you* 640K *bytes of user memory, and the display—either text or graphics—doesn't use that up.*

four palettes, each with three fixed colors and one user-selectable (out of a list of 16) background color. However, as with the Apple II, some ingenious programmers have managed to get far more out of the IBM PC than IBM put in. And, of course, there are the advanced and upward-incompatible graphics-display cards.

About the only commendable feature of the separate display cards is that they contain their own display RAM, although the address space had to be allocated within the 8088's 1-megabyte memory map. The IBM PC, XT, and compatibles allow you 640K bytes of user memory, and the display—either text or graphics—doesn't use that up.

Apple's people, in designing the Macintosh, reversed IBM's decisions. They made the Mac a closed box, ignoring the prime reason for the Apple II's continued success despite its close-to-obsolete technology. But they not only made a graphics display standard, they made it the focus of the entire machine. Unlike previous systems that distinguished between text and graphics display, everything on the Mac was done with graphics, including the icon-and-menu-based user interface. Adding the black-on-white display, the square pixels, the graphics routine in ROM, and a much more sensible RAM-to-screen mapping scheme, the result was a machine that looked like the expensive Star systems developed by Xerox, at a fraction of the price.

The graphics display on the Mac is straightforward in how it works. The 512- by 342-pixel image is scanned from left to right, top to bottom, out of the video-RAM area (called the screen buffer), each bit corresponding to one pixel. Unlike most graphics systems, a 0 corresponds to white and a 1 to black. The screen buffer is located near the top of user RAM, automatically adjusting upward for 128K-byte, 512K-byte and 1-megabyte Macs. And, because of the extensive routines in ROM, programmers can and should avoid writing directly into the screen buffer. While many of Apple's claims about the Mac were hyperbolic, the Mac did set a new standard for microcomputer displays. With multiple fonts and styles and Apple printers, the phrase "what you see is what you get," previously applied to margin-justifying word processors, took on a whole new meaning. And for all the criticism of the Mac interface, it has been quickly adapted to new and existing systems, indicating that Apple and Xerox must have done something right.

But graphics displays eat up memory, and the higher

(continued)

the resolution, the more memory needed (for the Mac, 22K bytes located at the top of user RAM). Add to that the fact that everything done on the Mac is graphics-based, and Apple should never have released the Mac as a 128K-byte machine incapable of user expansion. Word has it that Jobs was behind both decisions (no slots and small memory size); his departure has apparently made it easier for Apple to pursue developments like the Carla machine. Jobs was also against color graphics for the Mac, and that may be coming as well.

Now, two new systems with advanced built-in color graphics have hit the market. The Atari 520ST uses 32K bytes of user RAM for a display with three different resolutions: 640 by 400 pixels with 2 colors, 640 by 200 pixels with 4 colors, and 320 by 200 pixels with 16 colors. Mapping is fairly simple: Each horizontal group of 16 pixels maps to one, two, or four consecutive 16-bit words, depending upon the resolution currently being used. The result is a 1-, 2-, or 4-bit value used to index a color table holding 2, 4, or 16 values. Each color-table entry is 3 nybbles (12 bits) long, 1 nybble each for red, green, and blue. Only 3 of the 4 bits in each nybble are used, yielding 8 possible values for each color and 512 possible colors. The video RAM can be relocated to anywhere in memory on a 256-byte boundary.

The graphics on the 520ST are impressive, but there are a few problems. Like the Mac, the 520ST has no real hardware support for graphics processing, which means the 68000 must do all the work. And, as with the Mac, the ST's memory cannot be easily expanded, if it can be expanded at all. Also, the video output on the ST can be accepted safely only by an Atari monitor; the ST senses which type of monitor is connected and adjusts the output signal accordingly. Non-Atari monitors run the risk of burnout. (Of course, a standard Mac can't even accept an external monitor.)

This brings us to Commodore's Amiga, which represents the state of the art in microcomputer graphics. Like the ST, the highest resolution is 640 by 400 pixels—but you can use 16 colors instead of just 2 and select from a palette of 4096 colors instead of just 512. Low resolution is 320 by 200 pixels with 32 colors, and there are a few resolutions in between. You can redefine the color table and the horizontal resolution as the beam scans down the screen, giving you the ability to display hundreds of colors simultaneously. Video RAM must be located within the bottom 512K bytes of the memory map. Within there, it is freely relocatable and switchable; scrolling is done by incrementing registers rather than having to actually move data within the RAM. A true bit-plane approach is used, like many graphics systems for minis and mainframes. (See the product preview of the Amiga in the August BYTE [page 83] for more details on how bit planes and playfields work.)

As significant as these features are, the real power of the Amiga lies in the custom graphics hardware that

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removes much of the burden from the 68000 processor. This includes the Blitter (bit-mapped block-transfer device) and hardware support for sprites and other animation effects. The Amiga also offers a variety of video output signals: NTSC (National Television System Committee) for RF (radio frequency) modulators, composite, and RGB (red-green-blue), both analog and digital. The software for graphics is not as extensive nor as well done as that on the Mac. From what I can tell by the manuals, however, it isn't as restrictive, either. And the memory map is marvelous; the Amiga allows an additional 8 megabytes of RAM to be added via the expansion bus, offering a solution for memory-intensive processes.

A PARADOX

Amazing graphics do not a successful computer make, at least not necessarily. The Atari 520ST and the Amiga are both perceived as being glorified game machines because of their powerful color graphics; the comment often heard is, "Who wants business software that runs in color?" Yet color graphics have been pushed for the Mac as a way of penetrating further into the business market. These notions are contradictory but represent the problems that both types of systems face in being accepted outside of the home.

So, back to the original issue: Should Apple come out with a color Mac? I don't think so, since it raises more problems than it solves. Existing software won't be able to take advantage of it; the "color routines" in QuickDraw are very simple and aren't worth a whole lot; it would introduce a whole set of software/hardware-compatibility problems (which Apple will probably have enough of, anyway); without special hardware support, it will just lead to further degradation of performance (though that may be part of the reason for the dual 68000 processors supposedly used in Carla); all the current machines will be left out of the upgrade; and it will make the system more expensive. In short, Apple has a lot to lose and not that much to gain.

NEW PRODUCTS

A completely unexpected product—SideKick for the Macintosh—showed up in the mail from Borland International yesterday. It has a wide list of features, like a calendar, notepad, business calculator, simple telecom program, appointment/alarm list, auto-dialer, and so on. Many of these are installed as desk accessories, which is how you access them from within your application. I've run into a few problems (such as the Install program not "seeing" any of the accessories to be installed), and I can't really recommend it until I've had a chance to check it out some more. Look for a follow-up here next month.

Most books about the Macintosh have been useless fluff, at least as far as serious programming goes. The only exception has been the infamous, expensive, and obscure *Inside Macintosh* from Apple. Kathe Spracklen, coauthor of

(continued)

Macintosh Revealed is more than 500 pages long, well illustrated, and well laid-out, but it just doesn't cover everything I want it to.

Sargon II, once said that the book "consists of 25 chapters, each one of which requires that you understand the other 24 before reading it," which should give you some idea of what a pain it is to use. But for anyone wanting to do much with the Mac, it was the only real source of information (other than INFO-MAC, MacTutor, and your local Mac users group).

However, some decent books are finally coming out. Most notable is *Macintosh Revealed* by Stephen Chernicoff (Hayden Book Company). Volume 1 (*Unlocking the Toolbox*) has been out for some time. Volume 2 (*Programming with the Toolbox*) has just come out. Each volume costs $24.95. Chernicoff appears to know what he's talking about, and he does a good job of bringing a newcomer (albeit a dedicated one) up to speed on the Mac.

My two complaints about the book are that it is too short and it costs too much. But that is neither Chernicoff's nor, I think, Hayden's fault; the book is more than 500 pages long, well illustrated, and well laid-out, but it just doesn't cover everything I would like it to. Nor could it possibly. Considering how enormous *Inside Macintosh* is, and yet how tersely it deals with all the aspects of the Mac, I would imagine that a complete treatment of the Macintosh would run a few thousand pages in four volumes. My only real complaint is that *Macintosh Revealed* was not around a year ago.

In the Queue

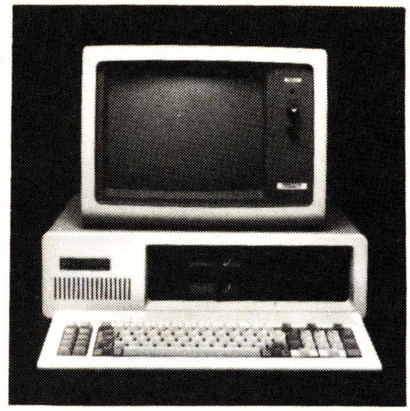
As I said at the start, I have piles of untested (and unopened) software that I need to get to. With luck, I can get settled quickly and get down to some serious work. I'm still coming up to speed on C and have many different C compilers to look at (including Microsoft's new C compiler and a few of the cheap C implementations for MS-DOS). Two new programming languages for the Apple II have shown up: Kyan Pascal and PROMAL. I want to give the ITC Modula-2 Software Development System a real workout, also.

In the meantime, take care, and I'll see you on the bit stream. ■

I'd like to acknowledge the help of Ryan Gale of Monitor Labs and Andy Jaros and Doug Bell of Oasis Systems in gleaning some of the graphics information about the IBM PC and the Atari 520ST. Thanks, guys.

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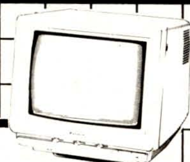


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Conducted by Steve Ciarcia

TERMINAL-MANAGEMENT PROCESSOR

Dear Steve,

In your January 1984 Circuit Cellar, you explored the NS455A terminal-management processor. I am constructing an NS455A-based school project. Where can I get an NS455A assembler?

Also, could you suggest a design for a single-step switch that would allow me to execute one instruction at a time?

RON SCOTT
Atlanta, GA

Jon Elson has written an assembler for the NS455A in Turbo Pascal that should work on any Pascal system. He can be contacted at 819 Marshall Ave., Webster Groves, MO 63119, (314) 962-6103.

If National Semiconductor's documentation is correct, there is no way to use a single-step switch on the NS455A. The documentation indicates that the clock must not go below 3 MHz. The correct way to do debugging is to write a debugger/monitor program. You can get control back from a breakpoint with either a hardware interrupt or by placing an MOVP3 *instruction over the breakpoint. Unfortunately, I know of no easy way to debug programs on the 8048 class of computers without extensive hardware support or a development system. The only alternative is trial and error, combined with careful bench-checking of your code. You should also look at the May 2, 1985, issue of* EDN *for an article on an 8048-family emulator that you can build. (The NS455A is a derivative of the 8048, and this circuit might be adapted for the NS455A.)*—Steve

SPEECH SYNTHESIS

Dear Steve,

Concerning your article in June 1983, "Use ADPCM for Highly Intelligible Speech Synthesis," I have built the speech-synthesis circuit, and it is operating well with my computer. My hobby is amateur radio, and I am able to use speech synthesis for a radio transceiver with prerecorded bulletins and news.

Can you help me locate the design of a 64K-byte DRAM system to connect to the Oki speech-synthesis circuit? The memory should provide about 15 seconds of recorded speech.

JOHN P. SZYKOLUK
Ste. Anne, Manitoba, Canada

There are many applications for speech synthesis, and your application is an interesting use of the ADPCM chips.

DRAM chips are a good choice for applications where density and power are a concern. One of the disadvantages of using these chips is that they must be refreshed, which necessitates extra circuitry. In your search for a memory system that connects directly to the Oki speech-synthesis circuit, you will probably find that building such a unit is not extremely difficult. In essence, a small computer system is necessary to control the memory.

In order to access the memory chips, you need to provide an address where the data will be written to and read from. Also, there must be logic that senses when there is data to be transferred. All this must be accomplished with some sort of sequential logic. In the article, the speech-synthesis circuit was interfaced to a Z80 microprocessor. Many CMOS microcontrollers are available that contain many useful functions. If you don't need all the bells and whistles of these microcontroller chips, you could use a CMOS microprocessor like National Semiconductor's NSC800. This uses the same instruction set as the Z80 and is useful in low-power situations.

To achieve 15 seconds of speech, you will need 60K bytes of data memory. This leaves about 4K bytes of directly addressable memory space for your use. That should be plenty of speech memory for this application.

The following books may be helpful in designing a microprocessor system: The Z-80 Microcomputer Handbook *by William Barden Jr. (Howard W. Sams, 1978) and* Build Your Own Z-80 Computer *by me (BYTE Books, 1980).*—Steve

SPEECH-ASSISTED WORKSTATION

Dear Steve,

I am interested in developing a speech-assisted workstation for the blind. Your article describing the SSI263 integrated circuit looks very useful ("Build a Third-Generation Phonetic Speech Synthesizer," March 1984). The rule-based software allows a level of personality to be integrated into the package (such as pronouncing the user's name correctly).

I would be implementing the system on an MS-DOS machine, the Tandy 1200. I am quite new at microcomputers, and I would appreciate your assistance in running the system in a non-Apple environment. Since Apple and Tandy use different machine languages, a list of the phoneme rules might be sufficient for software conversion. Any ideas on how the board fits into the actual slot would be helpful.

MICHAEL SALSBURG
West Chester, PA

There are many useful applications for the SSI263 speech synthesizer. Your application is another example of its usefulness to help disabled individuals.

While the Sweet Talker II was designed for the Apple II, the same principles are applicable to any computer. As mentioned in the article, the Apple's address-decoding capability simplifies the task of selecting the board. However, this does not present a major problem for other computers. It simply means that another method of address decoding must be supplied on the actual printed-circuit board.

As far as the software is concerned, the same basic commands outlined in the article can be used. While the machine language for your computer is different than that for the Apple II, you should be able to adopt the same ideas. Good luck. —Steve ■

Over the years I have presented many different projects in BYTE. *I know many of you have built them and are making use of them in many ways.*

I am interested in hearing from any of you telling me what you've done with these projects or how you may have been influenced by the basic ideas. Write me at Circuit Cellar Feedback, POB 582, Glastonbury, CT 06033, and fill me in on your applications. All letters and photographs become the property of Steve Ciarcia and cannot be returned.

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Inquiry 288

(continued from page 32)

HOMEBREW CPU

"EGO: A Homebuilt CPU, Part 1: The Software" by Clifford Kelley (September, page 229) was as untimely as all get-out and I loved it!

While attending Hope College as an undergrad, I had the opportunity to construct a 4-bit CPU designed by Dr. Jim VanPutten as a teaching tool for an electronics course. It sprawled across at least eight breadboards (the ones with all the little holes) and took forever to build, but it was invaluable for learning. The innards of the processor, such as a clear distinction of instruction cycles or what it means to "decode an instruction," were indelibly inscribed in my memory. I still have the hand-drawn construction and operation instruction in my desk drawer.

Over the years, it seems BYTE has leaned away from homebrew-type articles. Thank you for making Homebrewing the September theme. For me, the "derived education" Mr. Kelley speaks of has been a continued source of fascination of how simple even the complicated can become.

BRIAN J. MORK
Savoy, IL

AGRICULTURAL PROGRAMS SOUGHT

I am in the process of compiling public-domain, farm-business-related programs written in BASIC for increasing the productivity of farm-business operation. These programs will be helpful to farmers, universities, and agricultural agents.

In this connection, I would like to request the assistance of readers who might be able to share with me their programs or public-domain programs they have used to realize this valuable project. Proper credit and acknowledgment will be extended to the author and a final complimentary copy of the compilation will be given to those who have shared and donated their work. Write to me at the University of Puerto Rico–Mayaguez Department of Agricultural Engineering, POB 5114, College Station, Mayaguez, PR 00709.

E. J. RAVALO
Mayaguez, PR

STRUCTURING BASIC

Although Arthur Huston presented some useful ideas on the use of BASIC in his article "Structuring BASIC" (June, page 243), there is, I think, a better way to accomplish the same goals. This is through the use of a preprocessor to provide structured constructs. For instance, in Dr. *Dobb's Journal* #88, N. C. Shammas describes NBASIC, a powerful preprocessor for Microsoft BASIC. The enhancements include named subroutines with parameter passing, CASE statements, REPEAT . . . UNTIL statements, and alphanumeric labels.

The use of the intrinsic WHILE . . . WEND as well as CASE and REPEAT allows completely structured programming. You need never use GOTO; if you do, however, you can now identify the destination by a label rather than a line number.

Beyond providing the tools for good structured programming, NBASIC makes subroutine libraries a snap to implement. This is so because the subroutines can be named; one need never be concerned with line numbers. Your subroutine library should be created with an ordinary text editor and lines left unnumbered. Your application program should be created similarly; within it you can simply CALL the subroutines by name. Then all you need do is join the two text files, number the lines, and submit them to the preprocessor. These operations are easily done by way of a command-file processor (SUBMIT or EX in CP/M, SUB or ZEX in ZCPR3, or BATCH in MS-DOS). (Since it is not possible to pass command-line arguments, such as a filename, to BASIC programs, for easy command-file execution it is useful to modify NBASIC to read the name of its input file from another file. A short program can then be written in assembly language, Pascal, or C to read the command line and store its argument in this file and then exit or chain to the preprocessor.)

Although the linking, numbering, and preprocessing of a program slows down the development cycle somewhat, the time will be more than made up when it is necessary to modify the program a month or a year later.

On the whole, however, anyone desiring a structured, interpretive language that encourages the construction of reusable code really ought to be using FORTH.

DREAS NIELSEN
Corvallis, OR

Arthur Huston replies:
NBASIC certainly sounds like one of the more powerful BASIC preprocessors on the market, and it would no doubt be an effective tool in writing structured programs. My article, however, was aimed at the legions of programmers who learned Microsoft BASIC when they first bought

(continued)

Listing 3: A *subprogram for random-number generation.*

```
;Returns a new ISEED and the
  normalized RAND;
.8087
DSEG      SEGMENT PARA
            PUBLIC 'DATA'
;Required info for trancing back to
  FORTRAN
          DB          'RANDOM'
SP__SAVE              DW          0
          DD          RANDOM
FACTOR    DD          69069D
MODULO    DD          7FFFFFFFH
DSEG      ENDS
;
CSEG      SEGMENT PARA
            PUBLIC 'CODE'
          ASSUME CS:CSEG,SS:SSEG
;required by callin prog
          DW          DSEG
RANDOM PROC          FAR
          PUBLIC RANDOM
;for addressability of DATA seg
          MOV         AX,DSEG
          MOV         DS,AX
          ASSUME      DS:DSEG
          MOV         SP__SAVE,SP
;computation starts here with 8087
          FILD        DWORD PTR
                        MODULO
          FILD        DWORD PTR
                        FACTOR
;pointer for ISEED
          LDS         SI,ES:[BX]
          FILD        DWORD PTR [SI]
          FMUL
          FPREM
;return the new ISEED
          FIST        DWORD PTR [SI]
          FDIVB       ST,ST(1)
          LDS         SI,ES:[BX] + 4
;return the normalized RAND
          FST         DWORD PTR [SI]
;for addressibility of DATA seg
          MOV         AX,DSEG
          MOV         DS,AX
          FWAIT
          RET
RANDOM ENDP
CSEG      ENDS
SSEG      SEGMENT PARA STACK
            'STACK'
          DB          64 DUP(?)
SSEG      ENDS
          END
```

their machine and now write useful programs for themselves, their businesses, or their friends. Bringing structure to their programs through techniques rather than expensive add-on products seems a logical next step.

I also never meant that these techniques made BASIC "better" than FORTH or, for that matter, any language. There are thousands of people who program in BASIC because it is free, relatively simple, and accesses all the bells and whistles in their machine (graphics, sound port, etc.). Another alternative would be to buy one of the new versions of BASIC such as True BASIC or Better BASIC.

Random-Number Generation

The excellent article by Charles A. Whitney ("Generating and Testing Pseudorandom Numbers," October 1984, page 128) is most useful and timely for those who are serious about Monte Carlo programs using small computers. Most software houses supply simple random-number generators for BASIC, but they refuse to include the random-number generators in more advanced languages in order to avoid precisely those pitfalls mentioned in Whitney's article. Microsoft FORTRAN and IBM Professional FORTRAN are no exceptions. However, if you use the registers with 64 bits or more in a coprocessor such as an 8087, a very simple yet proven random-number generator is possible. One has to use assembly language in order to stay within the 8087 coprocessor until the desired random number is computed.

Listing 3 shows my version of a random-number generator that is a transplantation of RN32 from the venerable CERN Program Library (CERN Division DD, 1211 Geneva 23, Switzerland), which was originally written for 32-bit machines of CDC and IBM mainframes. It employs the linear congruential generator discussed in Whitney's article, with the multiplicative factor of 69069 and initial seed of 65539, and the product is taken modulo (2 to the 31st power). Notice that these selections conform with the rules of thumb in Whitney's article. The current version supplied is in a format to be linked with modules written in IBM Professional FORTRAN and to be invoked by CALL RANDOM(ISEED,RAND).

Yung Keun Lee
Baltimore, MD ■



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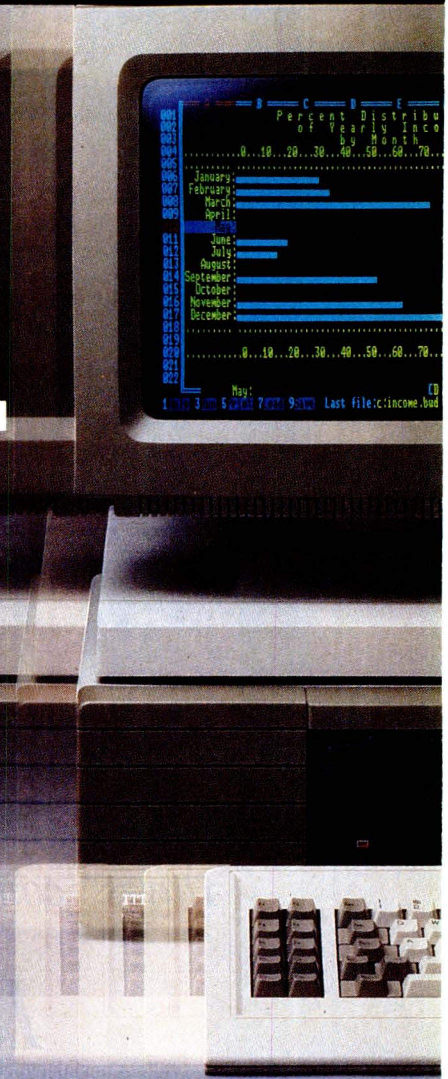
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NEW SYSTEMS

Apple-compatible Ace 2000 Series

The Ace 2000 series, like previous Franklin offerings, is compatible with the Apple II computer family. Franklin claims the 2000 can run 95 percent of the Apple II software.

The Ace 2000 has 128K bytes of memory and a detached keyboard with numeric keypad and user-definable function keys. The computer also has a parallel printer port, 80-column display capability, and a game port with both 9- and 16-pin connectors. The 2000 uses the GTE 65SC02 microprocessor, which allows it to generate the double-high-resolution modes of the Apple IIe and IIc.

The Ace 2000 is available in three versions: the 2200, with two disk drives and a list price of $999; the 2100, with one drive, for $849; and the 2000, with no drives, for $699. An optional high-resolution monochrome monitor (22-MHz bandwidth) is available for $139. Contact Franklin Computer Corp., Route 73/Haddonfield Rd., Pennsauken, NJ 08110, (609) 488-0666.

Inquiry 611.



The Franklin Ace 2200.

SBC88 Development and Control System

The SBC88 from Vesta Technology is a single-board computer based on the 8088 microprocessor. It comes with either two 2K by 8-bit RAM chips or one 8K by 8-bit RAM chip. The 2K version can be expanded to 8K of memory and has an EPROM programmer to burn 2716 EPROMs. The 8K version can be expanded to 32K of memory and has an EPROM programmer to burn 2764 EPROMs.

Both boards have an RS-232C port and 23 I/O ports, including two 8-bit output ports, two 8-bit input ports, seven individually addressable input ports, and seven high-current output ports. An 8-bit A/D converter provides eight channels for analog input; software routines allow analog output.

Programs for the SBC88 can be written in BASIC or FORTH, downloaded from any terminal via the RS-232C port, and copied from RAM to EPROM using the PROGRAM command. Once this is done the program will execute whenever the system is turned on. The 2K board costs $279 and the 8K board costs $319, including choice of language/operating system. Contact Vesta Technology Inc., Suite 101, 7100 West 44th Ave., Wheatridge, CO 80033, (303) 422-8088.

Inquiry 612.

Epson's Equity I

Epson's Equity I is an IBM PC-compatible desktop computer with a keyboard like the PC AT's. Standard features include serial and parallel ports, three expansion slots, 8088 processor, 256K bytes of RAM expandable to 640K, a front-panel power switch, MS-DOS 2.11, and GW-BASIC. It has a socket for an optional 8087 coprocessor.

The Equity I comes in three configurations. With one 360K 5¼-inch floppy-disk drive, it's priced at $995. With a second disk drive, it costs $1295. A version with one floppy-disk drive and a 20-megabyte hard disk is $2195.

Epson offers as options a 12-inch monochrome monitor ($149), a 13-inch color monitor ($549), a monochrome video adapter card ($129), and a color-graphics adapter card ($149). The Equity I is designed to use all standard IBM PC expansion hardware and software.

Contact Epson America Inc., 2780 Lomita Blvd., Torrance, CA 90505, (800) 421-5426; in California, (213) 539-9140.

Inquiry 613.

68010 UNIX System

The microFORCE-1 is a two-user VMEbus system with a five-slot backplane. Four slots are filled with a memory-management board, a memory card, a serial I/O card, and a Winchester/floppy-disk controller, leaving one expansion slot.

The memory-management board, Force's CPU-3VA, has a 68010 microprocessor running UNIX System V 1.0, 32K bytes of static RAM, and a serial port. The system has an MMU bypass option to decrease the execution time of UNIX system calls whenever possible. The DRAM 2.2 memory card comes with 1 megabyte of RAM. Its I/O card has three RS-232C ports, including a printer port and a port for synchronous or asynchronous communication.

The microFORCE-1 comes with one 5¼-inch floppy-disk drive and a 25-megabyte unformatted hard-disk drive. It costs $5995. Contact Force Computers Inc., 727 University Ave., Los Gatos, CA 95030, (408) 354-3410.

Inquiry 614.

(continued)

PERIPHERALS

HabaDisk for Atari ST

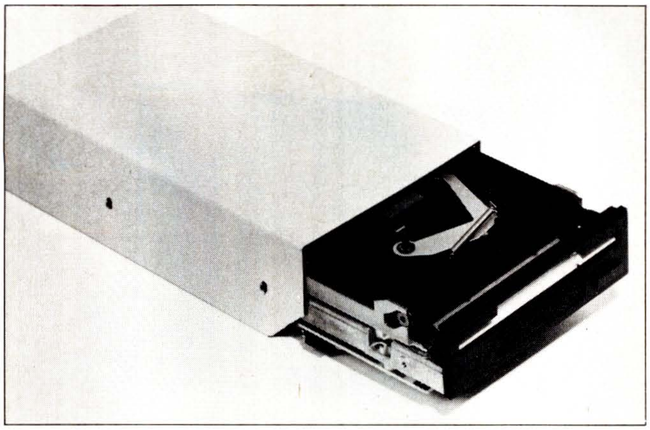
Haba Systems' HabaDisk is a 10-megabyte hard-disk expansion for Atari's ST computer, storing as much information as 12 double-sided disks. The HadaDisk includes its own power supply and an interface cable that attaches to the ST's hard-disk port. Haba says the drive is fully compatible with existing Atari ST hardware and software.

The HabaDisk is priced at $699.95. For more information, contact Haba Systems, 6711 Valjean Ave., Van Nuys, CA 91406, (818) 901-8828.
Inquiry 615.

9-track Tape Drive for IBM PC

The AN-9800-PC from Acknowledge is a 9-track tape subsystem for the IBM PC and Wang Professional computers. The tape drive allows data to be written to and read from the standard ½-inch tape on 7-inch reels used by many mainframe and minicomputer makers, permitting data transfer between microcomputers and mainframes.

Included with the self-loading, self-threading AN-9800-PC is a controller card that occupies a single expansion slot in the IBM PC or Wang PC. The 30-pound drive has a footprint of 9 by 14 inches. The IBM PC-compatible tape-drive system is priced at $4995, while the Wang PC version is $5995. An optional carrying case for the tape drive is $145. Contact Acknowledge Inc., 100 Pennsylvania Ave., Framingham, MA 01701, (617) 620-8843.
Inquiry 616.



PKI's SydeWyndr external disk drive.

External Disk Drive for Macintosh

SydeWyndr is a 3½-inch external disk drive for the Apple Macintosh. It accommodates single-sided microfloppy disks with a capacity of 400K bytes, formatted, and has a transfer rate of 489.6K bits per second.

SydeWyndr weighs 3½ pounds and comes with a case and connecting cable for $350. Contact PKI Inc., 2539 West 237th St. E, Torrance, CA 90505, (213) 539-2123.
Inquiry 617.

Citizen Daisy-Wheel, Dot-Matrix Printers

Citizen America has introduced two printers, one a daisy-wheel unit, the other a dot-matrix machine.

The Citizen Premiere 35 uses print wheels compatible with the Diablo 630; it can print at 35 characters per second and has a list price of $599. The printer also has a low operating noise level of 55 decibels and comes with an 8K-byte buffer. Other features include interchangeable interface cartridges, proportional spacing (selectable by a front-panel switch), and a 12-month warranty.

The Premiere 35 has a push-style tractor-feed mechanism. An optional dual-bin sheet feeder with envelope-feed capability is available for $400.

The dot-matrix Citizen 120D prints at 120 cps in draft mode. It has a list price of $249. You can select compatibility with either the IBM Graphics Printer or the Epson FX-80 by throwing a switch. Other features include a 25-cps correspondence-quality mode (selectable with a front-panel switch), a 4K-byte buffer, and a tractor-feed mechanism.

Contact Citizen America Corp., 2425 Colorado Ave., Santa Monica, CA 90404, (213) 453-0614.
Inquiry 618.

GTC Laser Printer

GTC Technologies' Blaser is an 8-page-per-minute laser printer based on Canon's LBP-CX printer engine. The Blaser emulates the Diablo 630 and NEC Spinwriter printers for text output and the text and graphics images of the IBM Graphics Printer (which was based on Epson's FX-80).

While in the IBM Graphics mode, alphanumeric characters are printed in a Courier font rather than the dot-matrix font, and graphics characters are printed taking advantage of 300-dpi capabilities. Standard graphics are output emulating the Epson's resolution, although additional escape-code sequences enable more advanced graphics features.

Each font includes boldface, compressed, expanded, superscript, subscript, and combinations of these formats, and all characters can be rotated 90 degrees and printed in landscape mode.

Ten font cartidges are available: American Typewriter, Apollo Proportional, Roman Proportional, Apollo Compressed, Elite, Prestige, Cobra, Courier Italic, Helvetica, and Legal. Each font cartridge is $99; a four-font cartridge is $289.

The Blaser includes a switch-selectable serial or parallel interface; both interfaces can be enabled simultaneously using an optional $499 adapter. A $699 adapter enables the parallel port plus four additional serial ports. Documents from each computer are buffered in the printer's 64K-byte RAM until earlier tasks are completed.

The Blaser printer has a list price of $2995. For more information, contact GTC Technologies Inc., 216 West Florence Ave., Inglewood, CA 90301, (213) 673-8422.
Inquiry 619.

ADD-INS

68020 Development System for IBM PC, XT, AT

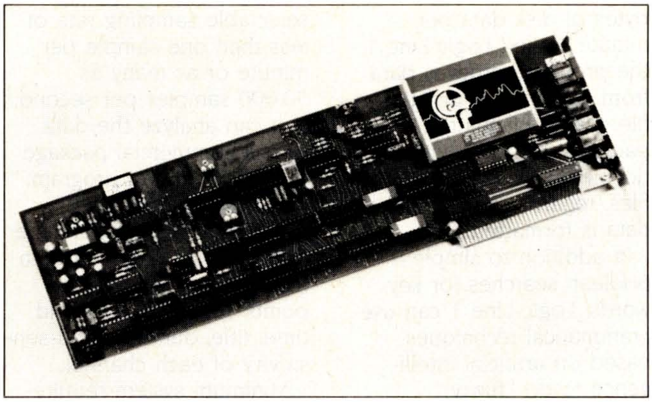
The IBM PC can be used as the basis for a 68020 development system by plugging the Language Resources PC-020 card into one of the PC's long slots and using the accompanying PC-020 software. You can write, assemble, test, and execute 68020 programs entirely within the PC-020/IBM PC system.

The PC-020 card contains a Motorola 68020 32-bit microprocessor, a 68881 FPU math coprocessor, and 1 megabyte of RAM. The RAM can be used as expansion memory by PC-DOS programs.

The development-system software includes a macro assembler, a symbolic debugger, a linker/locator, and documentation. Any executing 68020 program has full access to PC-DOS files. The assembler follows the Motorola assembler style and allows you to employ string macros, conditional assembly, structured control, 68881 instructions, and INCLUDE statements.

Language Resources is also offering C and Pascal compilers for the PC-020. These produce native code and generate full listings containing symbol tables and cross-references. The Pascal compiler is IEEE standard, and the C compiler is a complete Kernighan and Ritchie implementation with System V extensions. Both compilers can handle 16- and 32-bit integers, contain full floating-point support, and have run-time libraries.

The PC-020 costs $5995 and works with the IBM PC, XT, or AT (and plug-compatibles) with a hard disk and PC-DOS (or MS-DOS) 2.0 or higher. The C and Pascal compilers cost $895 each. Contact Language Resources Inc., 4885 Riverbend Rd., Boulder, CO 80301, (303) 449-6809.
Inquiry 620.



The CompuFone board from Computalker Consultants.

80287 Card for PC AT

MicroWay's 287Turbo card includes an 8-MHz Intel 80287 math coprocessor and its own 8-MHz crystal, allowing faster execution of complex math functions than is possible with a standard 6-MHz IBM PC AT. The design of the 80287 allows it to operate at a different clock speed than the main 80286 processor, but the 80287 normally shares the AT's 6-MHz crystal when it is inserted into the AT's coprocessor socket. The 287Turbo board plugs into the same socket but does not use the AT's crystal.

The 287Turbo card is designed so that the 80287-8 and clock crystal can be replaced with faster components when they are made available. A program is included to test all the 80287's functions.

The 287Turbo board is $395. Contact MicroWay Inc., POB 79, Kingston, MA 02364, (617) 746-7341.
Inquiry 621.

Telephone Management for the IBM PC

The CompuFone board for the IBM PC, XT, and compatibles is a full-length card comprising three subsystems: a digitizer, a Touch-Tone generator/decoder, and a telephone interface.

The speech digitizer works like a solid-state tape recorder. Voice messages can be recorded in RAM or in disk files through telephone or mike-in or line-in jacks using any of five possible bit rates. Speech is encoded using hardware data compression for economical storage; a hard disk is recommended—a 10-megabyte hard disk will hold only 70 minutes of speech. You must also have at least 128K bytes of RAM. Speech output can be transmitted over telephone lines, line-out jacks, or speaker-out jacks.

The Touch-Tone generator will initiate phone calls on either Touch-Tone or rotary (pulse) dial phones. The telephone interface monitors the call to make sure it has gone through, then relays your recorded voice message. The system can also detect an incoming call, answer with your voice, and record the caller's message.

The Touch-Tone decoder allows you to use any telephone keypad as a remote keyboard for your computer. It is designed to receive commands or enter data sent by the caller.

CompuFone costs $645; the manual can be ordered separately for $30. Contact Computalker Consultants, 1730 21st St., Santa Monica, CA 90404, (213) 828-6546.
Inquiry 622.

Custom Terminal Design

The 65/9028 VT is a controller board for a video terminal that emulates ANSI X3.64, DEC VT-52, and Lear Siegler ADM 3A terminals. The 80-column display mode includes a nonscrolling 25th line. Line graphics permit plotting, graphing, and complex forms display. Each of 10 function keys can contain a string of 32 characters. Separate serial communications and printer ports are also supported, and the company says that all polarities of composite and separate video and sync outputs are possible, with 50-Hz or 60-Hz vertical sync.

The 65/9028 VT includes 16K bytes of firmware and 8K of nonvolatile RAM on a single 5- by 6½-inch circuit board. The board is available as an assembled unit for $239. A kit version is $199; the bare circuit board with the ROM is $49. Contact Linger Enterprises Inc., POB 5783, Newport News, VA 23605, (804) 244-3874.
Inquiry 623.

(continued)

SOFTWARE

Graphics Software for Apple II Series

Chartics is a package of business and scientific graphics routines that runs on all Apple II computers. The software lets you plot arrays of up to 280 variables on two high-resolution pages of video memory.

Charts made with the program can be proportioned to fit into user-defined windows that you can scroll to any location on the screen. A scaling function lets you specify *x*-minimum, *x*-maximum, *y*-minimum, and *y*-maximum to plot a chart in oversize or undersize proportions or to display a section of a chart. This feature circumvents problems associated with negative numbers by letting you determine the scale and the part of the chart to be shown.

Chartics can import DIF or ASCII text files, so you can chart data directly from applications programs or from on-line services. It also loads and saves standard Apple binary picture files, so you can incorporate existing digitized images into charts. The program offers 32 colors on color monitors and 8 gray tones on monochrome monitors.

Chartics costs $250. It requires 64K bytes. Contact American Avicultural Art & Science Inc., 3268 Watson Rd., St. Louis, MO 63139, (314) 645-4431.
Inquiry 624.

Search Program with AI Capability

Clarity Software has released a data-retrieval program for the IBM PC series that reportedly can search at a rate of 110K bytes of disk data per minute. Called Logic-Line 1, the program retrieves data from any type of disk-based file. Clarity claims the package can work with document files or database files, regardless of how the data is formatted.

In addition to simple Boolean searches for keywords, Logic-Line 1 can use grammatical techniques based on artificial intelligence to do "fuzzy searches" or cross-searches for data that may not conform to the original keyword criterion but which may be relevant nonetheless.

Logic-Line 1 is written in C and, until the new year, has an introductory price of $100. Contact Clarity Software, POB 839, Chesterland, OH 44026, (216) 729-1132.
Inquiry 626.

Oscilloscope Package for IBM PC, XT, AT

Snapshot Storage Scope turns the IBM PC, XT, or AT into a digital oscilloscope and data-acquisition system. The program is capable of digital or analog triggered acquisitions, windowed displays, absolute and relative cursor readouts, time and magnitude readouts, channel labels, and selective recording of data to disk.

With Snapshot, you can acquire and display up to four channels of data at a selectable sampling rate of less than one sample per minute or as many as 50,000 samples per second. You can analyze the data with a commercial package or with your own program. Data can be displayed graphically or in tables. The display and the stored data files list the number of points collected, date and time, title, duration, and sensitivity of each channel.

Minimum system requirements are a PC or compatible, one double-sided double-density floppy-disk drive, 256K bytes of RAM, PC-DOS 2.0, an IBM color-graphics board or compatible, and a MetraByte or Data Translation analog I/O board. No programming is necessary.

Snapshot sells for $495 and comes with a 30-day trial period. A demo disk is $8. Contact HEM Engineering Co., 17025 Crescent Dr., Southfield, MI 48076, (313) 559-5607.
Inquiry 625.

Draw with Perspective

MacPerspective is an architectural-rendering program for the Macintosh that lets you construct wire-frame perspective drawings of houses, buildings, or other objects composed primarily of straight lines.

To create a perspective drawing, you specify the location of the observer and enter *x*-, *y*-, and *z*-coordinates of points on the object in either feet and inches or units and decimal units. The computer determines the location of each point as it appears in perspective and draws lines between successive points. (Or you can use the mouse to draw lines between points.) If you change the position of observation, the computer redraws the object as seen from the new viewpoint. The line drawing can then be used as a tracing master from which you can create a finished rendering.

Drawings can be up to 100 inches wide and printed by an Imagewriter or LaserWriter. With a 128K Mac, you can draw figures of up to 1100 points; with a 512K Mac, you can use 1900 points. The package provides a rapid zoom-in/zoom-out capability.

MacPerspective costs $189. Contact B. Knick Drafting, 313 Marlin Place, Melbourne Beach, FL 32951, (305) 727-8071.
Inquiry 627.

MS-DOS Version of CBC Tools

Minnow Bear Computers has released an MS-DOS version of its CBC Tools for use with DRI's CBASIC compiler. The supplement is intended to take advantage of the capabilities of MS-DOS 2.0 (the original is comprised primarily of functions portable between CP/M-80, CP/M-86, and MS-DOS). The functions in the supplement were written in assembly language.

CBC Tools for MS-DOS costs $175. Contact Minnow Bear Computers, POB 2233 Station A, Champaign, IL 61820-8233, (217) 398-6883.
Inquiry 628.

WHERE DO NEW PRODUCT ITEMS COME FROM?
The new products listed in this section of BYTE *are chosen from the thousands of press releases, letters, and telephone calls we receive each month from manufacturers, distributors, designers, and readers. The basic criteria for selection for publication are: (a) does a product match our readers' interests? and (b) is it new or is it simply a reintroduction of an old item? Because of the volume of submissions we must sort through every month, the items we publish are based on vendors' statements and are not individually verified. If you want your product to be considered for publication (at no charge), send full information about it, including its price and an address and telephone number where a reader can get further information, to* New Products Editor, BYTE, 425 Battery St., San Francisco, CA 94111.

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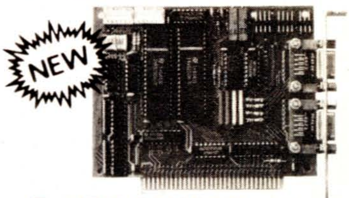
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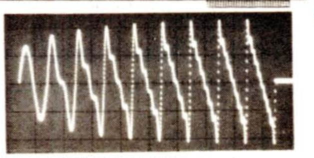
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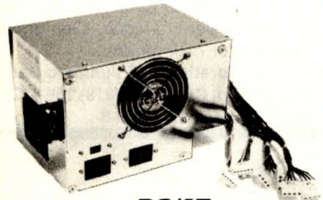
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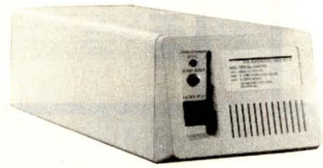
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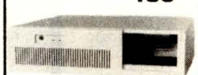
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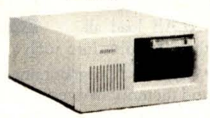
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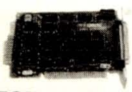
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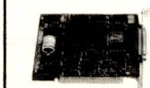
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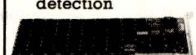
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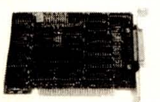
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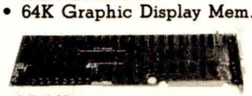
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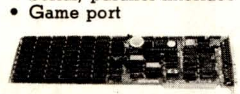
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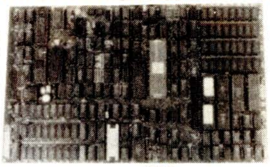
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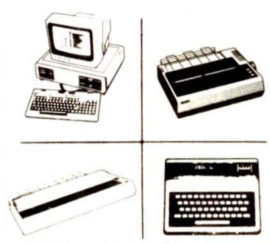
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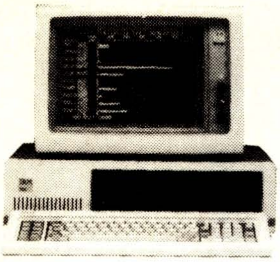
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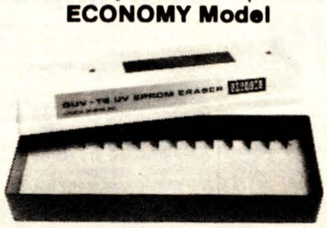
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- Erases 15 EPROMS in 20 minutes
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	Qty. 50	Qty. 150
5.25″ SSDD	.83 ea.	.80 ea.
5.25″ DSDD	.94 ea.	.92 ea.
5.25″ DSDD-HD	2.13 ea.	N/A
5.25″ SSDD-96TPI	.94 ea.	N/A
5.25″ DSDD-96TPI	1.06 ea.	N/A
3.50 SSDD-135TPI	1.84 ea.	1.68 ea.
3.50 DSDD-135TPI	2.40 ea.	2.28 ea.

NOTE: 3.50″ diskettes in Quantity 50 are packed in plastic library cases. That's why they seem to be a better buy. But there are only 5 diskettes to a case...so the bulk diskettes are really a better deal, unless you like expensive little library cases.

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One word of warning: this offer is limited only to supplies on hand. Once this inventory is gone, that's it. The prices stay the same...but there's no FREE Flip 'n File.

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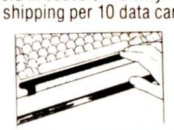
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	Qty. 20	Qty. 50
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5.25″ DSDD-96TPI	$2.51 ea.	$2.48 ea.
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100% certified 3M data cartridges

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Sold in cases of 10 only.
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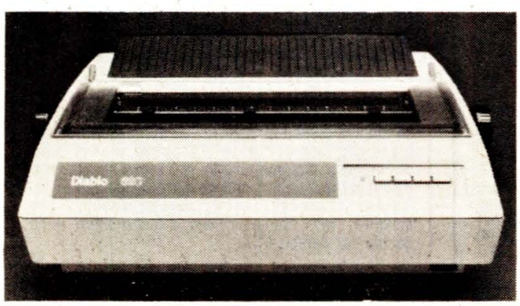
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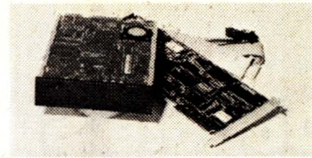
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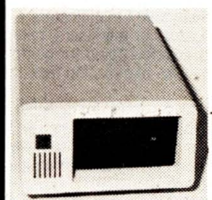
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22 Pin ST/LP	.29	.27
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28 Pin ST/LP	.39	.32
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72 Pin WW	7.25	6.95

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(CALL TOLL FREE FOR IDC's)

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IDC TYPE	ACP NO	NUMBER OF CONTACTS 10	20	26	34	40	50
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Ribbon Header Socket	IDSxx	.75	.95	1.35	1.50	1.85	2.10
Ribbon Header	IDMxx	—	5.25	5.95	6.75	7.25	8.25
Ribbon Edgecard	IDExx	1.70	2.15	2.50	2.60	3.70	3.95
Wirewrap Header	IDHxxW	1.80	2.90	3.75	4.25	4.95	6.50
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NOTE: To order insert number of contacts in place of xx in ACP part number.

ORDER QUANTITY OF 50pcs (mixed) AND TAKE AN ADDITTIONAL 10% OFF.

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LX-80 (100 cps)	245.00
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FX-80 +	339.00

PRINTER SPECIALS

Toshiba 1340	$479.00
Toshiba 341	999.00
Toshiba 351	1175.00
Star SG-10	239.00
Brother 1509	399.00

6800

68000	$19.95	6810	$ 2.85	6850	$ 3.25
68000L10	39.95	6820	3.75	6852	5.65
6800	2.90	6821	2.90	6860	7.90
6802	7.75	6828	14.50	6875	6.75
6803	18.95	6840	12.75	6880	2.20
6809E	9.50	6845	11.95	68047	22.95

6500

6502	$4.50	6504	$6.75	6522	$5.25
6502A	6.90	6507	9.75	6532	9.50
6502B	9.50	6520	4.25	6551	11.50

8000

8035	$ 5.75	8214	$ 3.75	8259	$ 6.75
8039	5.75	8216	1.95	8271	69.95
8080A	2.95	8224	2.20	8275	26.95
8085A	4.90	8226	1.95	8279	8.75
80C85A	9.95	8228	3.40	8282	6.25
8086	24.50	8237	13.75	8283	6.25
8087-2	129.95	8237-5	15.95	8284	5.50
8088	17.50	8238	4.25	8286	6.45
8089	88.95	8243	3.95	8287	6.45
8155	6.75	8250	10.50	8288	11.95
8156	6.75	8251	4.25	8289	44.95
8185	26.95	8251A	5.95	8292	12.95
8202	23.95	8253	6.75	8741	27.95
8203	37.95	8255	4.25	8748	24.50
8205	3.25	8255A	5.95	8749	24.50
8212	1.95	8257	5.75	8755A	34.95

Z-80

	2.5MHz	"A" 4.0MHz	"B" 6.0MHz
Z80-CPU	2.25	2.75	6.95
Z80-CTC	2.50	3.75	9.25
Z80-DART	7.50	8.50	17.95
Z80-DMA	8.00	8.95	17.95
Z80-PIO	2.95	3.50	9.50
Z80-SIO/0	8.50	9.50	22.95
Z80-SIO/1	8.50	9.50	—
Z80-SIO/2	8.50	9.50	22.95
Z80-SIO/9	8.50	9.50	—

Z8030	$34.95	Z8001	$34.95	Z6132	$32.95
Z8530	34.95	Z8002	34.95	Z8671	37.95

DISK CONTROLLERS

uPD765	$24.95	1797	$21.95	6843	$28.95
1771	15.95	2791	32.95	8272	19.95
1791	22.75	2793	32.95	1691	6.95
1793	21.50	2795	32.95	2143	6.95
1795	21.50	2797	27.95	9216	12.95

CRT CONTROLLERS

6845	$11.95	8275	$28.50	TMS9918	$39.50
68B45	17.95	7220	34.95	8350	39.95
6847	11.50	5027	17.95	6545	14.95
46505	14.75	5037	21.95	8002	19.95
68047	19.50	NEC7220 Graphics			34.95

UARTS/USARTS

1602B	$3.95	2350	$ 8.95	IM6403	$ 8.75
1013A	3.95	8250	10.50	TMS5501	14.95
1015A	6.75	IM6402	7.75	2651	8.95

EPROMS

1702 (1mS)	$ 3.90	2732A-4 (450nS)	$ 4.50
2708 (450nS)	3.65	2732A (250nS)	6.95
2758 (5V)	5.50	2732A-2 (200nS)	8.95
2716 (450nS)	3.75	2764 (450nS)	4.50
2716 (350nS)	5.50	2764 (250nS)	6.50
2516 (5V)	5.50	2764 (200nS)	8.50
TMS2716	7.50	TMS2564 (450nS)	9.95
TMS2532	5.60	MCM68764 (450nS)	19.95
2732 (450nS)	4.60	MCM68766 (350nS)	21.95
2732 (250nS)	6.00	27128-3 (300nS)	9.50
2732 (200nS)	8.00	27128 (250nS)	15.95
CMOS EPROMS		27C32	$9.95
27C16	$8.95	27C64	12.95

STATIC RAMS

2101 (450nS)	$1.89	MK4118	$4.95
21L02 (450nS)	.99	TMM2016-2 (200nS)	3.10
2102-1 (450nS)	.79	TMM2016-15 (150n)	3.95
21L02-2 (250nS)	1.39	TMM2016-1 (100nS)	3.00
2111 (450nS)	2.75	HM6116P-4 (200nS)	4.75
2112 (450nS)	2.75	HM6116P-3 (150nS)	3.25
2114 (450nS)	1.45 8/9.50	HM6116P-2 (120nS)	5.75
2114L-4 (450n)	1.69 8/12.50	HM6116LP-4 (LP)	3.60
2114L-3 (300n)	1.79 8/13.30	HM6116LP-3 (LP)	3.95
2114L-2 (200n)	1.89 8/13.90	HM6116LP-2 (LP)	3.95
2147 (55nS)	4.50	Z6132 (300nS)	32.95
4044-4 (450nS)	3.25	HM6264P-15 (150)	14.95
4044-3 (300nS)	3.75	HM6264LP-15 (LP)	16.95
4044-2 (200nS)	4.35	74S189 (35nS)	1.85
UPD410 (100nS)	3.75	93415 (50nS)	3.95
5101 (CMOS)	3.50	93425 (50nS)	3.95

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1103 (300nS)	.79	TMS4416 (150nS)	$7.75
4116N-2 (150nS)	1.29 8/ 9.95	41256-150 (150n)	8.95
4116N-3 (200nS)	1.19 8/ 8.25	41256-200 (200n)	7.95
4116N-4 (250nS)	.89 8/ 5.99	TMS4050 (300nS)	1.85
4164N-150 (150n)	1.59 9/11.95	TMS4060 (300nS)	1.85
4164N-200 (200n)	1.49 9/10.00	MM5280 (300nS)	1.85
4164N-120 (120nS)	6.25	UPD411 (300nS)	1.85
TMS4164 (150nS)	5.95	MM5298 (250nS)	1.85

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79¢ ea. PACKAGE OF 100 — "IBM PC®" DS/DD, Hub Rings, Tyvac Cover, Major Mfgr. **WOW! Supply Limited**

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4002	.22	4030	.39	4066	.39	4507	1.10
4006	.79	4031	3.25	4069	.28	4508	1.90
4007	.22	4032	2.15	4070	.35	4510	.79
4008	.95	4034	1.91	4071	.28	4511	.79
4009	.39	4035	.79	4072	.28	4512	.79
4010	.39	4037	1.95	4073	.28	4514	1.18
4011	.24	4040	.75	4075	.28	4515	1.79
4012	.24	4041	.75	4076	.75	4516	1.19
4013	.35	4042	.65	4077	.35	4518	.85
4014	.75	4043	.85	4078	.35	4520	.75
4015	.39	4044	.69	4081	.29	4555	.95
4016	.35	4046	.80	4082	.29	4556	.95
4017	.65	4047	.89	4085	.95	4566	1.35
4018	.79	4048	.99	4086	.95	80C95	1.50
4019	.39	4049	.35	4093	.45	80C97	.49
4020	.69	4050	.34	4094	2.95	MC14408	12.95
4021	.69	4051	.75	4098	1.90	MC14409	12.95
4022	.69	4052	.75	4099	1.85	MC14410	9.95
4023	.25	4053	.75	4501	.69	MC14411	11.95
4024	.59	4055	3.95	4502	.95	MC14412	12.95
4025	.25	4056	2.95	4503	.49	MC14419	4.95
4027	.45						

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74C02	.29	74C85	1.89	74C175	1.15	74C374	2.35
74C04	.29	74C90	1.15	74C240	1.89	74C901	.59
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LM300H	.99	NE592	2.70	LM3914	$2.95
LM301N	.35	LM709N	.55	LM3915	2.95
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LM311CN	.62	LM733	.98	CA3023	2.75
LM312H	1.75	LM739	1.85	CA3039	1.25
LM318CN	1.45	LM741CN	.33	CA3046	1.25
LM318H	1.55	LM741H	.40	CA3059	2.85
LM319N	1.19	LM741N	.29	CA3060	2.85
LM320 (see VRs)		LM747	.65	CA3065	1.69
LM324N	.55	LM748	.55	CA3080	1.10
LM339N	.95	LM1014	1.15	CA3081	1.60
LM340 (see VRs)		LM1303	1.90	CA3082	1.60
LM348N	.95	LM1310	1.45	CA3083	1.55
LM358CN	.65	MC1330	1.65	CA3086	.80
LM359	1.75	MC1349	1.85	CA3089	2.95
LM360N	2.95	MC1350	1.15	CA3096	3.45
LM370N	4.95	MC1358	1.65	CA3130	1.29
LM373N	3.95	MC1372	6.75	CA3140	1.15
LM376N	3.75	LM1414	1.55	CA3146	1.79
LM377N	1.90	LM1558H	2.99	CA3160	1.49
LM380CN	.85	LM1800	2.35	LM13080	1.25
LM380N	1.05	LM1812	8.10	LM13600	1.45
LM381N	1.59	LM1830	3.40	LM13700	1.45
LM382N	1.35	LM1871	5.45	LF347	2.19
LM383N	1.95	LM1872	5.45	LF351	.60
LM384N	1.75	LM1877	3.20	LF353	.99
LM386N	.89	LM1889	1.90	LF355	1.10
LM387N	1.29	LM1896	1.70	LF356	1.10
LM389N	1.15	ULN2001	1.95	LF357	1.39
LM392N	.69	ULN2003	1.49	TL071CP	.79
LM723N	.48	XR2206	3.75	TL072CP	1.35
LM723H	.55	XR2207	2.90	TL074CN	1.90
NE531	2.85	XR2208	2.40	TL081CP	.59
NE555	.35	XR2211	3.75	TL084CN	1.90
NE556	.65	LM2877P	2.00	TL494	4.10
NE558	1.49	LM2878P	2.25	TL496	1.65
NE561	23.50	LM2900	.83	TL497	3.20
NE564	2.85	LM2901	.99	MC3423	1.49
LM565	.95	LM2903	.69	MC3453	4.95
LM566	1.45	LM2907	2.45	MC3456	1.29
LM567	.85	LM2917	2.85	MC3459	3.75
NE570	3.85	LM3900	.55	MC3469	5.25
NE571	2.90	LM3905	1.15	MC3470	7.95

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7805T Also 8, 12, 15, 24V	.69	7905K Also 12, 15, 24V	1.39
78L05, 12, 15V	.65	79L05, 12, 15V	.75
78M06C	.89	LM309K	1.25
78MG/79MG	1.49	LM317H/K	1.25/3.85
78H05KC	8.75	LM323K	4.85
7805K Also 12, 15, 24V	1.29	LM337K	3.75
		LM338K	6.75
7905T Also 8, 12, 15, 24V	.79	LM350T	4.55
		LM350K	4.75

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BR1941	11.50	5832	3.75	76477	3.75
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8038	3.75	3341	4.50	Votrax	39.95
5369	3.50	11C90	13.25	Digitalker	34.95
58167	12.25	MC15906	2.95	LM13600N	1.95
SP1000 Speech	$9.95	TR1863 5V UART			$4.25

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ADC0804	3.45	DAC0800	4.75	1408L8	2.85
DAC0806	1.90	DAC0808	2.85	DAC100	7.95
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ALL WITH MOUNTING KIT

7400

7400	$ .18	7446	$ .68	74123	$ .45	74176	$ .69
7401	.18	7447	.65	74125	.42	74177	.69
7402	.18	7448	.68	74126	.44	74179	1.34
7403	.18	7450	.19	74128	.49	74180	.75
7404	.18	7451	.19	74132	.45	74181	1.75
7405	.23	7453	.19	74136	.75	74182	1.15
7406	.49	7454	.19	74141	.85	74184	2.25
7407	.49	7459	.25	74142	2.95	74185	2.25
7408	.24	7460	.37	74143	3.70	74190	.67
7409	.19	7470	.29	74144	2.95	74191	.67
7410	.19	7472	.29	74145	.59	74192	.67
7411	.24	7473	.33	74147	1.49	74193	.67
7412	.38	7474	.34	74148	1.19	74194	.67
7413	.34	7475	.38	74150	1.09	74195	.67
7414	.49	7476	.34	74151	.55	74196	.75
7416	.49	7479	4.60	74152	.67	74197	.86
7417	.49	7480	.69	74153	.53	74198	1.15
7420	.19	7482	.95	74154	1.19	74199	1.15
7421	.35	7483	.45	74155	.69	74221	1.19
7422	.45	7485	.55	74156	.59	74251	.75
7423	.58	7486	.35	74157	.59	74273	1.65
7425	.29	7489	1.95	74158	1.65	74276	1.89
7426	.29	7490	.35	74159	1.58	74279	.75
7427	.25	7491	.65	74160	.79	74283	1.40
7428	.55	7492	.45	74161	.69	74284	2.90
7430	.18	7493	.35	74162	.69	74285	2.90
7432	.29	7494	.85	74163	.69	74290	1.49
7437	.25	7495	.50	74164	.69	74298	1.49
7438	.29	7496	.69	74165	.69	74365	.55
7439	.58	7497	2.70	74166	.85	74366	.55
7440	.19	74100	1.50	74167	2.75	74367	.55
7441	.79	74107	.24	74170	1.25	74368	.55
7442	.45	74109	.37	74172	4.75	74390	1.45
7443	1.15	74116	1.45	74173	.69	74393	1.33
7444	1.15	74121	.29	74174	.69	74490	2.25
7445	.68	74122	.44	74175	.69		

74LS00

74LS00	$ .22	74LS113	$ .38	74LS247	$ .74
74LS01	.22	74LS114	.39	74LS248	.98
74LS02	.22	74LS122	.45	74LS249	.98
74LS03	.22	74LS123	.95	74LS251	.59
74LS04	.24	74LS124	2.75	74LS253	.59
74LS05	.25	74LS125	.49	74LS257	.59
74LS08	.27	74LS126	.49	74LS258	.59
74LS09	.28	74LS132	.59	74LS259	2.95
74LS10	.25	74LS136	.39	74LS260	.59
74LS11	.33	74LS138	.59	74LS261	2.49
74LS12	.33	74LS139	.59	74LS266	.55
74LS13	.39	74LS145	1.19	74LS273	1.45
74LS14	.59	74LS148	1.38	74LS275	3.29
74LS15	.33	74LS151	.55	74LS279	.59
74LS20	.26	74LS153	.55	74LS283	.68
74LS21	.29	74LS154	1.49	74LS290	.88
74LS22	.29	74LS155	.69	74LS293	.78
74LS26	.29	74LS156	.69	74LS295	.98
74LS27	.29	74LS157	.69	74LS298	.88
74LS28	.29	74LS158	.69	74LS324	1.75
74LS30	.25	74LS160	.69	74LS347	1.95
74LS32	.33	74LS161	.69	74LS348	1.95
74LS33	.53	74LS162	.69	74LS352	1.25
74LS37	.35	74LS163	.69	74LS353	1.25
74LS38	.39	74LS164	.69	74LS363	1.29
74LS40	.25	74LS165	.90	74LS365	.48
74LS42	.44	74LS166	1.90	74LS366	.48
74LS47	.74	74LS168	1.15	74LS367	.45
74LS48	.74	74LS169	1.15	74LS368	.45
74LS51	.25	74LS170	1.40	74LS373	1.39
74LS54	.29	74LS173	.67	74LS374	1.33
74LS55	.29	74LS174	.67	74LS375	.69
74LS73	.39	74LS175	.67	74LS377	1.38
74LS74	.34	74LS181	1.95	74LS385	1.95
74LS75	.39	74LS190	.85	74LS386	.45
74LS76	.39	74LS191	.85	74LS390	1.15
74LS78	.39	74LS192	.78	74LS393	1.15
74LS83	.59	74LS193	.78	74LS395	1.15
74LS85	.69	74LS194	.69	74LS399	1.47
74LS86	.39	74LS195	.69	74LS424	2.95
74LS90	.54	74LS196	.79	74LS668	1.75
74LS92	.54	74LS197	.79	74LS670	2.29
74LS93	.54	74LS221	.89	81LS95	1.45
74LS95	.75	74LS240	.95	81LS96	1.45
74LS96	.89	74LS242	.95	81LS97	1.45
74LS107	.39	74LS243	.95	81LS98	1.45
74LS109	.39	74LS244	1.25	25LS2521	2.65
74LS112	.39	74LS245	1.45	25LS2569	3.50

74S00/PROMS*

74S00	$.29	74S74	$.55	74S158	$.99	74S260	$1.19
74S02	.29	74S85	1.89	74S160	2.49	74S280	1.95
74S03	.29	74S86	.55	74S161	1.89	74S287*	1.95
74S04	.45	74S112	.55	74S174	1.19	74S288*	1.95
74S05	.45	74S113	.55	74S175	1.19	74S373	2.09
74S08	.39	74S114	.55	74S188*	1.49	74S374	2.09
74S09	.39	74S124	2.69	74S194	1.49	74S387*	1.95
74S10	.35	74S132	1.39	74S195	1.49	74S471*	5.95
74S11	.35	74S133	.45	74S196	1.49	74S472*	4.95
74S15	.35	74S134	.50	74S240	1.99	74S473*	4.95
74S20	.35	74S135	.69	74S241	1.99	74S474*	4.95
74S22	.35	74S136	1.39	74S242	1.99	74S475*	4.95
74S30	.35	74S138	.89	74S243	1.99	74S570*	2.95
74S32	.45	74S139	.89	74S244	1.99	74S571*	2.95
74S38	.89	74S140	.55	74S251	1.19	74S572*	4.95
74S40	.39	74S151	.99	74S253	1.19	74S573*	4.95
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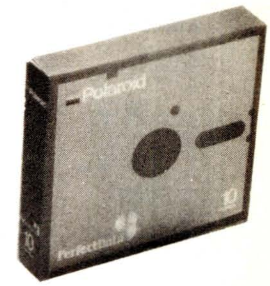


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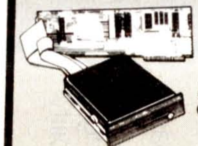
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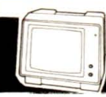
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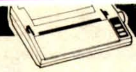
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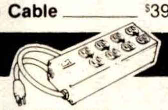
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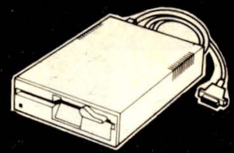
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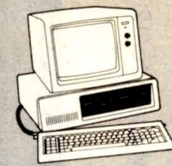
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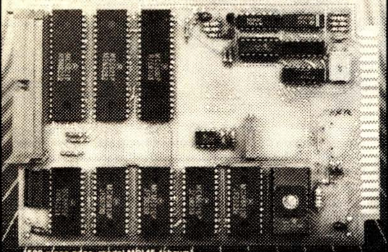
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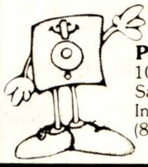
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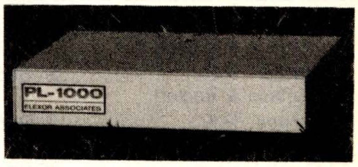
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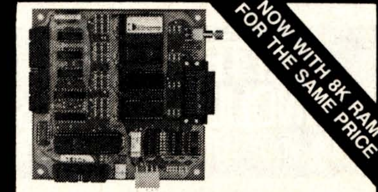
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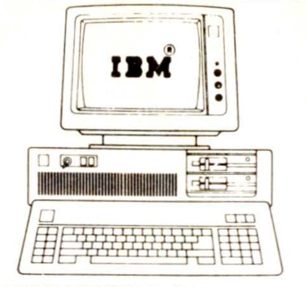
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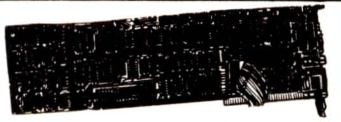
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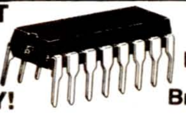
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HM6116LP-3	2048x8	(150ns)(CMOS)(LP)	1.59
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LP=Low power

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MCM6665	65536x1	(200ns)(5V)	1.95
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TMS4416	16384x4	(150ns)(5V)	4.95
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41256-200	262144x1	(200ns)(5V)	2.95
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5V=Single 5 Volt Supply REFRESH=Pin 1 Refresh

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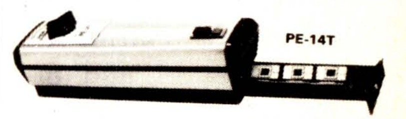
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5V=Single 5 Volt Supply 21V PGM=Program at 21 Volts

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PE-24T	YES	12	9,600	$175.00

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8039	1.95
8080	2.95
8085	2.49
8087-2	139.95
8087	109.00
8088	6.95
8088-2	9.95
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8155-2	3.95
8748	7.95
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74LS10	.16	74LS193	.69
74LS11	.22	74LS194	.69
74LS12	.22	74LS195	.69
74LS13	.26	74LS196	.59
74LS14	.39	74LS197	.59
74LS15	.26	74LS221	.59
74LS20	.17	74LS240	.69
74LS21	.22	74LS241	.69
74LS22	.22	74LS242	.69
74LS27	.23	74LS243	.69
74LS28	.26	74LS244	.69
74LS30	.17	74LS245	.79
74LS32	.18	74LS251	.49
74LS33	.28	74LS253	.49
74LS37	.26	74LS256	1.79
74LS38	.26	74LS257	.39
74LS42	.39	74LS258	.49
74LS47	.59	74LS259	1.29
74LS48	.69	74LS260	.49
74LS51	.17	74LS266	.39
74LS73	.29	74LS273	.79
74LS74	.24	74LS279	.39
74LS75	.29	74LS280	1.98
74LS76	.29	74LS283	.59
74LS83	.49	74LS290	.89
74LS85	.49	74LS293	.89
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74LS95	.49	74LS365	.39
74LS107	.34	74LS367	.39
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74LS112	.29	74LS373	.79
74LS122	.45	74LS374	.79
74LS123	.49	74LS375	.95
74LS124	2.75	74LS377	.79
74LS125	.39	74LS378	1.18
74LS126	.39	74LS390	1.19
74LS132	.39	74LS393	.79
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74HCT11	.69	74HCT241	2.19
74HCT27	.69	74HCT244	2.19
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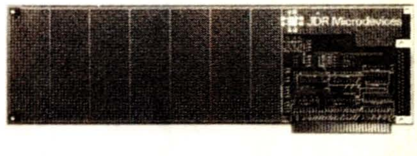
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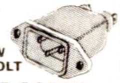
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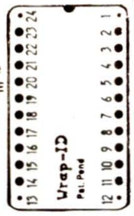
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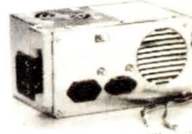
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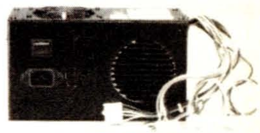
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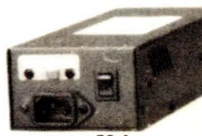
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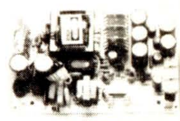
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27	50V	.05	.0022	50V	.05
33	50V	.05	.005	50V	.05
47	50V	.05	.01	50V	.07
68	50V	.05	.02	50V	.07
100	50V	.05	.05	50V	.07
220	50V	.05	.1	12V	.10
560	50V	.05	.1	50V	.12

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.047µf	50V	.15	.47µf	50V	.25

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RADIAL			AXIAL		
1µf	25V	.14	1µf	50V	.14
2.2	35V	.15	10	50V	.16
4.7	50V	.15	22	16V	.14
10	50V	.15	47	50V	.20
47	35V	.18	100	35V	.25
100	16V	.18	220	25V	.30
220	35V	.20	470	50V	.50
470	25V	.30	1000	16V	.60
2200	16V	.70	2200	16V	.70
4700	25V	1.45	4700	16V	1.25

COMPUTER GRADE 44,000µf 30V 3.95

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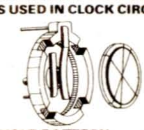
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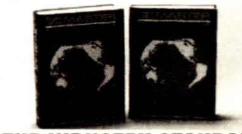
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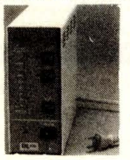
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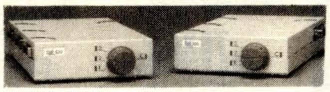
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SP120


SP110

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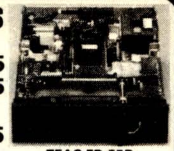
MPI

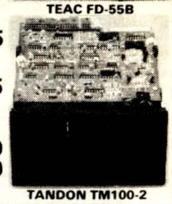
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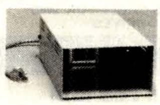
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5¼" DRIVE ENCLOSURES

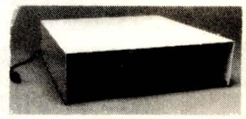
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CAB-1FH5


CAB-2SV5


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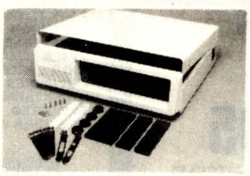
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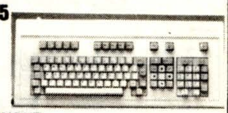


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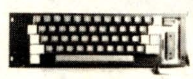
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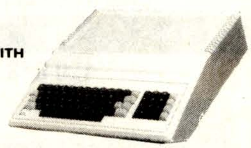


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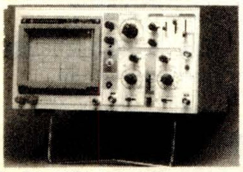


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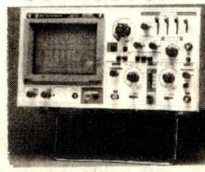


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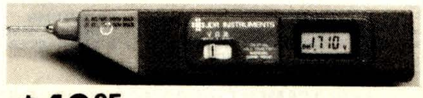
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WANTED: Library of the Marine Environmental Sciences Consortium seeks tax-deductible donation of IBM PC or compatible with 256K or 512K bytes of RAM and 360K disk drive(s), 10- to 20-megabyte hard disk, monitor, and dot-matrix printer. MESC, POB 369, Dauphin Island, AL 36528.

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NEEDED: Information on NAPLPS or sources to acquire information on this subject. Johann G. Kiermeyer, Hauptstrasse 27, 8425 Neustadt/Donau, West Germany.

WANTED: June 1977 BYTE or copy of Dan Fylstra's article "Interfacing the IBM Selectric Keyboard Printer," pages 46–52 and 133–139. Any other information appreciated for this task. Roger G. Smith, Rt. 2, Box 366, Laurel, MS 39440, (601) 428-7484.

FOR TRADE: Macintosh public-domain programs. Will share with users groups only. Send newsletter and list of your public-domain files and digitized images. Also, inquire about International Mac User Group Network. John Allen, POB 40045, Portland, OR 97024-0045.

WANTED: Persons interested in robotics to form international club with newsletter, etc. Send SASE. The TIme machine, 30 Melken Court, Baltimore, MD 21236.

WANTED: People interested in starting nationwide MC-10/6803/6801 users group and public-domain software exchange. Send SASE. Jon Porter, 6501 Amber Crest, Indianapolis, IN 46220.

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FOR SALE: Rockwell AIM 65 with 4K: $250. ExpandoRAM with 16K: $100. Kimsi S-100 expansion board for AIM: $60. SSM VBIB video board: $80. Each has documentation. John Ip, 9465 McNaught Rd., Chilliwack, British Columbia V2P 6E9, Canada.

FOR SALE: Apple IIe 80-column card with manual. Excellent condition. $70 or best offer. Michael Smith, D-8 Gatewood, Greenwood, SC 29646.

FOR SALE: LDP Lightning One S-100 PC, 10-MHz 8086, ½-megabyte RAM, 5-megabyte Winchester, handles three 40-megabyte drives. Will also configure as 8-inch system. $1900. R. Morein, 1570 Arran Way, Dresher, PA 19025, (215) 646-4894.

WANTED: Apple II with damaged case or keyboard. Need a working motherboard. Glen Button, POB 536, Cheshire, CT 06410, (203) 272-9251.

FOR SALE: 12-inch Sanyo CRT-36 green monochrome monitor with cable. $100 or best offer. Two TEAC 55B DS/DD disk drives. $75 each or best offer. Excellent condition. Michael J. Vargo, 2999 Lutheran Rd., Gilbertsville, PA 19525.

FOR SALE: ADDS Regent 200 terminal with detachable keyboard. Best offer over $600. Tony Preston, 119 Hickory Lane, Medford, NJ 08055.

FOR SALE: Assembled and tested Slicer single-board computer. 8-MHz 80186, 128K RAM, almost new. $700. Charles Ng, 49 Showers Dr. #474, Mountain View, CA 94040, (415) 948-5174.

WANTED: 15-inch white-on-black Hitachi high-resolution monitor or equivalent. Harry J. Weber, M.D., Route 8, Box 554, Hot Springs, AR 71913, (501) 767-6266.

FOR SALE: Olivetti LUC 401, line-control unit, TTY interface, communications interface, RS-232 serial interface, and RS-232 cable. Excellent condition. $600 (Canadian) or best offer. K. Molohon, POB 562, Sudbury, Ontario P3E 4P8, Canada.

FOR SALE: TRS-80 Model 16A with 128K, 68000 board, two 8-inch floppy drives (1.25 megabytes each). $3000. Ralph Stegner, 66 South Broad St., Fairborn, OH 45324, (513) 878-3447.

FOR SALE: Passport Music System with keyboard. Also, Mountain Hardware's Music System with light pen. Brand new. Will sell for dealer cost. Robert M. Reinhart, 4816 North Rutherford, Chicago, IL 60656, (312) 286-6606.

FOR SALE: Applied Concepts Morphy Encore chess computer, USCF rating 1800+. $150. Steve Ferrero, 8601 First Ave., North Bergen, NJ 07047, (201) 869-5351.

FOR SALE: CompuPro 8085/88 system with 64K, two 8-inch 600K drives, three serial ports, TeleVideo 910+ CRT, Okidata 82A printer, Mullens I/O, and more: $3200. Excellent working order. Gary Ragsdale, 8631 Wine Leaf Cove., Germantown, TN 38138, (901) 754-9522.

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AVAILABLE: Public-domain Life, Core War, Line Automation, and Wa-Tor. All written and compiled with Turbo Pascal 3.00 and constantly updated. Source code included. Runs on 64K IBM PC with graphics card. Send SASE. Doug Church, 2112 Noyes St., Evanston, IL 60201.

FOR SALE: Xerox 820 board (compatible with Big Board). Includes all sockets, resistors, capacitors, schematics, and assembly instructions. Contains monitor and character set on EPROMs. $55 or best offer. Gary M. McComas, Route #1, Box 454, West Hamlin, WV 25571, (304) 824-5664.

FOR SALE: Complete set of Heathkit H-11 computer manuals, includes schematics and documentation. Make offer. Trade: Have extra January and February 1979 issues of BYTE; need January and February 1977. Will sell/buy if necessary. Luis Mulford, 205 Post Oak, Lake Jackson, TX 77566.

UNCLASSIFIED ADS MUST *be noncommercial, from readers who have computer equipment to buy, sell, or trade on a onetime basis. All requests for donated computer equipment must be from nonprofit organizations. Programs to be exchanged must be written by the individual or be in the public domain. Ads must be typed double-spaced, contain 50 words or less, and include full name and address. This is a free service; ads are printed as space permits.* BYTE *reserves the right to reject any unclassified ad that does not meet these criteria. When you submit your ad* (BYTE, Unclassified Ads, POB 372, Hancock, NH 03449), *allow at least four months for it to appear.*

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FOR SALE: Inexpensive expansion interface, printer, modem, and disk drive for TRS-80 Model I, Level II. Paul Ngaopravej, 67-01 Woodside Ave., Woodside, NY 11377.

FOR SALE: MPX-16 bare board in original sealed envelope, with BIOS and manuals. $210 including shipping. Merton Bollman, 18002 Atkinson Ave., Torrance, CA 90504.

FOR SALE: Zenith Z-90 loaded and Z-37 drives. Morrow MD1-E with MDT-70 terminal. Excellent condition. Will consider any reasonable offer. Scott Kudika, 237 Main St., New Kensington, PA 15068, (412) 335-3472 or 337-1717.

FOR SALE: Atari 810 disk drive with interface card. $200 or best offer. Don C. Jacobs, VF-103 MC, FPO New York, NY 09501-6117.

FOR SALE: Three Industrial Micro-Systems Model 282 16K static RAM boards. Phantom line, RAM disable, PWR/MWR, and memory-management capability using 450-ns 2114s, with documentation. $120 each. G. Bober, POB 36428, Grosse Pointe Woods, MI 48236, (313) 884-2133.

FOR SALE: Tektronix 4012 with controller and 10-inch diagonal screen. Hazeltine 1421 with keyboard and 12-inch alphanumeric screen. Best offer. Sharon Mott, Great Plains Gasification Associates, POB 1149, Beulah, ND 58523.

FOR SALE: 80-column card for the Apple IIe: $50. Ed Rambeau, 55 West 74th St., New York, NY 10023, (212) 724-0458.

TRADE: Will trade my Apple II public-domain software for yours. Send SASE. Dale Flatow, 7684 South Logan Ave., Oak Creek, WI 53154.

FOR SALE: DAK Microsystems 6/232, S-100 board with six programmable RS-232 channels plus 16-channel master/slave interrupt controller. Preproduction with full documentation. Best offer over $175. K. S. Kolberg, 52105B Friars Court, South Bend, IN 46637, (219) 277-6154.

FOR SALE: Dual Remex ⅔-height 5-inch fully IBM PC-compatible DS/DD drives in cabinet with power supply. Almost new. Manual included. $220. Benny Bamgbade, POB 440323, Houston, TX 77244-0323, (713) 550-4651.

FOR SALE: Motorola UDS 208 A/B 4800-bps data modem. $1500 (Canadian). Doug Anderson/Ernie Reimer, 118 Midland St., Winnipeg, Manitoba R3E 2Y6, Canada, (204) 775-8531.

FOR SALE: Data General/One with 256K bytes, screen, two 3½-inch drives, printer, internal battery, and carrying bag. $3500. Michael Balamuth, 300 East Main St., Centerport, NY 11721, (516) 367-8390.

FOR SALE: BYTE: 1978–1984 complete, except for February and December 1979 and June 1981. Also November and December 1977. $30 per year. Martin Evans, 325 East 52nd St., New York, NY 10022, (212) 355-1926.

FOR SALE: TI-99/4A. Excellent condition, hardly used. Manuals and cables included. $45 plus shipping. Anthony Switzer, Rt. 2, Box 254, Campobello, SC 29322, (803) 895-2659.

FOR SALE: Kaypro 4 '84 Plus 88. CP/M machine (64K) with factory-installed MS-DOS SWP coprocessor (256K), built-in clock, and 300-bps modem. $1200 or offer. Eric Hart, 103 McGraw Place, Ithaca, NY 14850, (607) 272-3691.

FOR SALE: HP 2116B "mini" computer. In working order, but some assembly may be required. $200, best offer, or trade. Billy Vitro, 10480 Orange Ave., Cupertino, CA 95014.

FOR SALE: Two Visual 50 terminals. Emulate DEC VT52, ADDS Viewpoint, LSI ADM 3A, and Hazeltine Esprit terminals. Nearly new. $400 each or best offer. Will swap both for one SwTPC 8212 terminal. Dwight Lanpher, Box 472, Northeast Harbor, ME 04662, (207) 276-5350.

WANTED: Used IBM PC with dual disk drives, memory expansion (at least 256K), monochrome graphics card, and serial and parallel ports. State price and other details. L. D. Thomas, 104 Birchwood Rd., Baltimore, MD 21228.

B·O·M·B

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BOMB *Results*

A TECHNICAL EVOLUTION

Mark Garetz, author of "Evolution of the Microprocessor," which appeared in September's 10th Anniversary Section, wins the $100 bonus. Howard Austerlitz wins $50 for second place for his theme, "A Parallel-to-Serial Printer Port Adapter." The columns by Steve Ciarcia and Jerry Pounelle continue in their popularity with readers, as does Robert Kurosaka's Mathematical Recreations.

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